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ANIMAL MECHANICS.[1]

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Reference was made to a former lecture before the Michigan Short-horn Cattle Association, in which the relations of heredity and variation to the improvement of live stock were discussed, and attention was called to the flexibility of the constitution of domestic animals that made them susceptible to the modifying influences of the conditions in which they are placed—so that variations are constantly produced by changes in food and management, and constant care must be exercised to select the animals presenting desirable variations to fix and retain them as inherited characters.

In presenting these fundamental principles in the improvement of animals, many important details were necessarily omitted, and at the present time my purpose is to supplement the general subject of heredity and variation, by calling attention to some of the latest contributions of science to the philosophy of feeding, and notice their relations to the principles of selecting breeding stock, that are often overlooked by inexperienced breeders in their efforts to improve their animals in special qualities.

In the lecture referred to, animals were compared to machines for converting the vegetable products of the farm

[1]Abstract of a lecture before the Michigan Association of Breeders of Improved Live Stock, Dec. 17, 1892.

into animal products of greater value. This simile, which is often made, is of greater significance than at first sight would appear, and if breeders will keep in mind the fact that they are, in effect, providing machines for doing work in the manufacture of meat, milk, wool, muscular power, or other animal products, from the raw materials derived from the soil, the means of improvement will be more readily understood.

From this point of view the breeders of live stock should have a deep interest in the general progress of agriculture, as any improvement in crop growing must be to their advantage, from the larger supply of raw materials for the manufacture of animal products, which should increase the demand for animal machines to perform the work with the greatest economy, and at the same time turn out a finished product of a quality than can be disposed of at renumerative prices in the market.

This simile of a machine makes apparent the fallacy of the old notion that the animal that eats the least is the best for the farmer. It would certainly be a poor recommendation for a machine to say that it could work up but a small amount of raw materials. The object of the farmer is, profit, and in every department of production the aim should be to obtain the largest net return from the raw materials he has to dispose of. The more the animal machine can do of useful work, the greater its value to the farmer, if the results are obtained with the greatest economy.

Another popular error will be readily corrected by looking upon animals as machines for doing work. The notion has too generally prevailed that animals are composed simply of flesh and blood and bones, etc., and that when they are furnished with food containing the materials which enter into the composition of their tissues, it would, in some mysterious way, be converted into animal substances. This is, however, a partial or one-sided view, that does not represent the whole truth.

Farmers are constantly dealing with the forces of Nature, and a knowledge of natural laws cannot fail to aid them in their mastery. The applications of the law of the conserva-

tion of energy to animal and vegetable physiology, which have recently been made, are of great assistance in giving clear and correct notions in regard to the economy of living beings, and we learn that the materials used in the constructive processes of plants and animals are not of greater importance than the motive power required to convert them into living substances.

The law of the conservation of energy has revolutionized modern physics, and the industries have been directly benefited by its applications, and its influence in agriculture when rightly applied, can hardly be overestimated. Faraday pronounced it "the highest law in physical science which our faculties permit us to perceive," and it has been claimed to be the most important discovery of the present century.

Energy has been defined as "the power of doing work, or overcoming resistance." Its familiar manifestations we call heat, light, motion, electricity, etc. These different forms of energy are mutually convertible, without gain or loss, or, in other words, the energy of the Universe is a constant quantity that is neither increased or diminished by the transformations it undergoes.

All forms of energy may be transformed to heat, and this furnishes a convenient unit or standard for measuring it. The unit of heat is the amount required to raise one pound of water one degree in temperature. Its mechanical equivalent is 772 foot-pounds, which is the unit for measuring work. That is to say, the heat required to raise one pound of water one degree in temperature, is equivalent to the force required to raise a weight of one pound 772 feet, or a weight of 772 pounds one foot, which is, conveniently expressed, as 772 foot-pounds, the weight in pounds being multiplied into the distance in feet through which it is raised. Foot-pounds divided by 2000 will give the result in foot-tons, which is often used.

When a weight of one pound is raised 772 feet, it represents, in that position, 772 foot-pounds of potential, or stored energy, and when this weight is allowed to fall the entire distance without interruption, the stored energy is transformed into active energy or motion, and when this motion is arrested on

completion of the fall of 772 feet, heat is liberated sufficient to raise one pound of water one degree in temperature, or, the equivalent of the energy required to raise the weight to the height from which it fell. This serves to illustrate what is meant by the conservation of energy.

The transformation of food constituents into animal subtance involves the performance of work by the animal machinery of nutrition, which is carried on at the expense of the stored energy of the food consumed. An expenditure of energy in work is as necessary to convert corn or grass, into animal subtance, as in the hauling of a load on the road, and the term work is as applicable, in the same sense, in the one case as in the other. Sheep growing wool, cows giving milk, and animals fed for the butcher, should, therefore, be recognized as working animals, as well as those used in draft, or in lighter, more rapid work on the road.

Internal work must be done in the first place to convert vegetable substances into animal substance; and, in the next place, an additional amount of work must be done in the further conversion of animal substance into the special animal products of meat, milk, wool and muscular force, which are the real sources of profit in feeding. Moreover, this internal work involves the wear and tear of the animal machine, which unlike purely mechanical devices, makes its own repairs at the expense of the raw materials it is its mission to convert into animal products.

An important question here presents itself; how is the food consumed by animals disposed of, and what purpose does it serve in the animal economy? The correct answer to this is of great practical importance and interest to every farmer, and especially to breeders of improved stock.

In the first place, materials are provided for growth, and for the needed repairs of the system, but only a small proportion of the food constituents are utilized for these purposes, as will be seen from the following table giving the results of experiments at Rothamsted.

Each 100 pounds of food constituents consumed by fattening animals were disposed of as follows:

Constitutents of Food. 100 lbs. each.	Stored in increase.			Voided in Excreta.		
	Oxen.	Sheep.	Pigs.	Oxen.	Sheep.	Pigs.
	lbs	lbs	lbs	lbs	lbs	lbs
Proteids	4.1	4.2	13.5	95.9	95.8	86.5
Non-proteids	7.2	9.4	18.5	14.1	8.9	4.1
Minerals or Ash	1.9	3.1	7.3	98.0	97.0	92.7
Dry Substance	6.2	8.0	17.6	36.5	31.9	16.7

The food constituents not accounted for have served a useful purpose in their liberated energy for the performance of work, and their residues have been exhaled in the gaseous form, and the surplus energy as animal heat. Growing animals, and cows giving milk, will retain, or utilize a larger proportion of the food constituents, but even then much the larger part of the material elements of the food are discharged in the excreta.

In the next place, the potential or stored energy of the food is made available in all of the work done by the system, and it is the sole source of power in all of the processes of the animal machine.

From the prominence given to the chemical theory of nutritive ratios in some of our agricultural papers, farmers are asked to believe that success in feeding depends upon following certain theoretical formulas, giving the proportions of food constituents in the rations fed, while the animal machine which does the work of manufacturing valuable animal products, and the motive power that makes it efficient, are entirely ignored. I can only say in passing, that in the present state of knowledge, we cannot formulate the constituents of foods in chemical terms, to serve as practical guides in feeding. The machine itself, is the most important consideration, and its capacity, for doing the work required of it, is of far greater significance than the proportions of the comparatively small amount of the so-called nutritive constituents stored up, or used by the animal.

Let us for a moment consider the facts in regard to the construction and repair of other farm machinery, as reapers, mowers, threshing machines, etc. When we take an exact inventory of the items of cost, in the construction and repair of these machines, we find that the materials of which they are made, or are used in repairing them, make but a small fig-

ure in the expense account, and that the work done in shaping and fitting the materials in proper relations, represent a very large proportion of the real cost of the machine or of the repairs that may be made. In repairing a machine, a few cents may pay for the iron or wood used, while several dollars would be required to pay for the work done.

The same principle holds good with the animal machine, both in its original construction and its repairs. But a small proportion of the food constituents are utilized in the processes of nutrition, and a very large amount of energy is constantly expended in the work of transforming these materials into animal substance and animal products.

The real significance of these facts will best be seen by making a quantitative estimate of the energy expended, and the transformations it undergoes in organic processes, as represented in the following table giving an approximate statement of the composition of one acre of corn, and of a fat ox analyzed at Rothamsted.

	Constituents	Corn one Acre. 3360 lbs. grain 3840 " stalks 7200 lbs. total		Fat Ox. Fasted Live Weight, 1419 lbs. (Contents of Stomach, etc., 85 lbs.).	
		Per cent.	Lbs.	Per cent.	Lbs.
A	Carbon	39.7	2858	31.6	448
	Hydrogen	7.0	504	9.7	137
	Oxygen	48.8	3511	46.5	660
	Nitrogen	1.3	90	2.4	34
	Ash	3.3	237	3.9	55
	Potash	1.10	79	0.18	2.6
	Phos. Acid.	0.53	38	1.55	22
B	Water	17.1	1232	45.5	646
	Proteids	7.8	562	14.5	206
	Fat	3.3	237	30.1	427
	Carbhydrates	68.5	4932		
	Ash	3,3	237	3.9	55
	Potash	1.10	79	0.18	2.6
	Phos. Acid	0.53	38	1.55	22

Stored energy representing work done.	17,083,000 foot-tons, equivalent to the work of one horse continuously for 719 days.	3,381,000 foot-tons, equivalent to the work of one horse day and night for 142 days.

A chemical analysis of the corn shows (division A of the table), that it is composed of 2858 lbs. of carbon; 504 lbs. of hydrogen; 3511 lbs. of oxgen; 90 lbs. of nitrogen; and 237 lbs. of ash, or mineral constituents, the most important of which are potash 79 lbs., and phosphoric acid 38 lbs. The ash constituents and the nitrogen are alone derived from the soil.

We have here the elements of which the crop is composed, but division B of the table shows that they represent water 1232 lbs.; proteids 562 lbs.; carbhydrates 4932 lbs.; and ash 237 lbs. These are the facts furnished by chemistry in regard to the composition of the acre of corn, but they do not represent the whole truth.

To transform the simple elements of division A of the table into the complex organic compounds of division B, energy must be expended and work done, and the energy so used is stored up in the organic substances formed as an essential condition of their constitution. The amount of this stored energy is represented in division C of the table, and it is an important factor in the composition of the crop of corn, as it is one of the essentials in animal nutrition.

This stored energy of the corn does not, however, represent the total expenditure in the growth of the crop. Experiments show that for each pound of dry organic substance formed by the growing corn, about 300 lbs. of water will be exhaled, or thrown off by the plants in the form of vapor. To convert water into vapor involves an expenditure of energy, and this for the acre of corn would be approximately equivalent to the work of 24 horses for six months without intermission. Water is likewise evaporated from the soil as one of the essential conditions of fertility, and this calls for a further expenditure of energy, which under our climatic conditions may be estimated at about twice the amount expended in exhalation from the plants themselves. Taking all of these processes together, the

energy expended directly and indirectly in Nature's invisible unobtrusive work of growing an acre of corn, must be equivalent to the work of 76 horses, day and night, for six months.

This energy is all derived from the heat and light of the sun. The importance of proper soil conditions to favor the required transformations of energy in the growth of the crop will readily be seen.

The motive power of the animal machine, in all of its processes of nutrition and growth, is derived exclusively from the stored or potential energy of their food, and we may ask how this energy is liberated and made available in the animal economy.

As the energy used in its construction is stored up by the plant as an essential condition of its constitution, any disintegration of its organic substance will liberate the stored energy in the form of heat. This may be brought about in several ways. 1.—The plant may be burned, and the heat produced represents its stored energy. 2.—Microbes feeding on organic substances tear them apart and liberate the stored energy in the form of heat. The heat produced in the familiar processes of fermentation and putrefaction, all of which are caused by microbes, is but the stored energy of the organic substances on which they feed. 3.—The digestive processes of animals involve a disintegration of the food constituents, and liberate their potential energy for use in the processes of animal nutrition.

Turning now to the table, for the composition of the fat ox, we find it represented in division A, as consisting of simple elements, and in division B the complex compounds built up from these elements are given. It will be seen that work has been done, and energy expended in transforming the simple elements of division A into the complex compounds of division B, and, as in the case of the corn, the estimated amount of this expenditure of energy is given in foot-tons, and horse power, in division C of the table.

The popular notion that the proteids, fat and carbhydrates of the corn are directly converted into the proteids and fat of the ox that eats them, (division B), does not take into account

all of the factors concerned. We have seen that energy must be expended in work to convert vegetable substances into animal substances, and this energy can only be obtained by tearing apart the vegetable compounds through the processes of digestion, and liberating their stored energy. In this process the vegetable compounds of the food are resolved almost into their elements, and from these comparatively simple substances by means of the energy liberated, the proteids and fats of the ox are manufactured.

The complex animal substances thus formed are continually undergoing change. The wear and tear of the animal machine involves a disintegration of its organic substance, and its stored energy is liberated as heat. This may in part be used again in the processes of repair, but a large proportion leaves the body as animal heat.

As in the case of the corn, the stored energy (division C of the table), of the fat ox does not represent all of the energy expended in building up its organic substance. A constant process of repair has been going on to replace the waste resulting from the wear and tear of the system, which involves a continuous expenditure of energy—and the loss arising from the energy thrown off from the body as animal heat, (radiation), and expended in vaporizing the water exhaled from the skin, (perspiration), must be replaced at the expense of the stored energy of the food to keep the machinery of nutrition, in efficient activity.

The facts presented are sufficient to show that the transformations of energy are important factors in the economy of plants and animals, and that the materials of which they are composed cannot be looked upon as the sole subjects of interest in farm economy. The tendency to make the compounding of food rations the prominent subject for consideration, conflicts with the interests of the breeders of improved stock, and misleads the farmers who are induced to look upon it as the real source of profit. This reference to the subject of feeding is made with the two-fold purpose of calling attention to the fallacy of feeding experiments in which the chemical composition of foods is made the prominent or sole object of interest,

while the importance of the improvement of the live stock of the farm is wholly ignored; and to remind breeders that they are fully warranted in claiming that improved animals are entitled to the first place among the means of an improved agriculture, as machines for manufacturing the crops grown on the farm into marketable products.

The most serious obstacles to the progress of agriculture at the present time arise from the one-sided and misleading statements that are made in the name of science by those who have but a superficial knowledge of Nature's laws, and their intimate relations to farm practice. The experiment station reports, on the feeding of animals, fail to give a full statement of all of the factors that may influence the results, and too often the record is made to conform to hasty assumptions, or false theories, so that it is difficult to find a grain of truth in the mass of chaff that is scattered broadcast over the country.

As the remarkable progress made in other productive industries has been largely owing to improvements in machinery, so progress in agriculture must depend, to a great extent at least, upon the further improvement of the animal machines that are so essential to success in the business of farming, and we must look to the breeders of the pure breeds to accomplish this desirable object.

It will not answer to rest satisfied with the present high development of the pure breeds and their more general diffusion on the farms of the country, but the aim of every intelligent breeder must be to still further increase their useful qualities in special directions. Notwithstanding the decided superiority of the pure breeds over the average farm stock, there is still a wide margin for improvement, as there are good reasons for believing that even the best animals do not utilize more than one-half of the available energy of their food in useful work.

The largest profit can only be realized with animals that have the ability to consume and utilize in useful work, an amount of food considerably in excess of what is required in the needed repairs of the system. This involves severe work,

and one of the first essentials to be considered is that of stamina and constitution, or, in other words, the capacity for hard work and powers of endurance, or the same qualities in this respect that all working animals should possess.

These qualities are largely determined by heredity, and selections for breeding purposes should be made with reference to these qualities in the ancestors. Good sanitary conditions must of course be maintained, to secure a continuance of robust health and an active performance of the normal functions of nutrition.

Prepotency.

Strength of constitution or powers of endurance must not be confounded with prepotency, or the quality of holding a preponderating influence in the act of reproduction. Many animals that are prepotent in transmitting their own qualities, are deficient in constitution, and their offspring lack that active and vigorous performance of the nutritive organs that is essential to stamina and powers of endurance in useful work. Prepotency arises from uniformity in the characteristics of ancestors for many generations, and these characters may or may not be desirable.

In the improvement of the pure breeds with their present high development of valuable qualities, an accumulation of slight variations must be the aim. We cannot expect to gain any wide departure from present characters at a single step. Progress can only be made by a succession of short steps, and their sum will represent the real advantage gained. Small items determine the difference between gain and loss in the present activity of the industries, and in agriculture we must recognize the importance of slight improvements in each detail of general management as the only available method of making real progress.

Breeding to a Type.

In making selections for breeding, an ideal type of excellence representing definite valuable qualities, should be strictly

adhered to. This type, in all cases, should represent the highest development of characters that indicate the posession of the desired useful qualities. The form should be that which represents a special adaptation to the particular purpose in view. It is well known that the general form of animals is correlated with particular functions. The form of the roadster differs from that which is suited for heavy draft, and the type for rapid meat production is different from that giving the best results in the production of milk.

The law of correlation has, however, a further application. There is not only an adaptation of the general form to the kind of work that can best be done, but the different organs of the body have correlated relations that are quite as significant. An excessive activity, or development of one organ, or set of organs, diminishes the activity or development of the system in other directions. That is to say, the system has a capacity for utilizing a certain amount of energy, and if it is largely expended in one direction there is less to be expended for other purposes. If the tendency to lay on fat predominates, the milk producing functions must suffer a corresponding diminution, and severe muscular work will diminish the tendency to lay on fat, or produce milk.

To give permanency and uniformity to the ideal type that has been adopted, selections for breeding must be strictly confined to animals having the desired characters, within the limits of a distinct breed, or of a single family of a distinct breed. This is in effect establishing, or fixing, family characters in the particular breed. The constitution or physical stamina of the family type should not be lost sight of in attempts to secure other desirable characters, as on it will depend the efficiency and profitable exercise of the special functions that have been cultivated and fixed as family characters.

All coarseness should be avoided. Improvements in all breeds have been made by securing a greater refinement of the system, or in diminishing the proportion of coarse parts. Large bones, with apparent good reason, have been looked upon as an indication of imperfect nutrition, and as a general

rule, to which there are few, if any exceptions, they are correlated with coarseness in other parts. The wear and tear of the animal machine is greater in such cases, and a larger expenditure of energy is required in its repairs.

INHERITED HABITS.

Aside from the general inherited habits of animals with which you are all familiar, as the tendency to early maturity, or the habit of milk production throughout the year, or in what is called the trotting instinct, there are inherited habits of the nutritive organs themselves which should not be overlooked.

Habits are cultivated and established by their systematic exercise, and the desirable habits of the nutritive organs can only be cultivated and maintained by their constant exercise, or, in other words, by liberal feeding, and the direction in which the liberated energy of the food is expended must, at the same time, be determined and promoted by cultivating the general and special habits of the system. If, for example, milk is a leading object, in connection with a liberal supply of food, from which energy is freely liberated through the inherited activity of the nutritive organs—a sufficient capacity of the udder and other organs concerned in milk production must be provided—and a dominant tendency to the expenditure of the available energy in the milk producing function must be kept up by gentle treatment and regularity in milking and feeding. Judgment and skill must be exercised and attention given to many details, all tending in the same direction, to give the desired bias to the energies of the system.

The application of general principles will be found a better guide in practice than any specific empirical rules, and the habits of the system developed by judicious exercise and cultivation, must be fixed by systematic selection as hereditary characters.

GENERAL PURPOSE ANIMALS.

We can only call attention to some of the principles already presented to illustrate this special subject. There is, undoubt-

edly, a greater difficulty in securing two qualities on a high plane of excellence, than to obtain an extraordinary performance in a single special direction.

Milk and meat production are not strictly incompatable, and a high degree of excellence may doubtless be obtained with both. Greater skill is, however, required to combine the two qualities and retain them for any time, than to obtain a high development of either of them alone. A certain balance, or equilibrium, in the expenditure of energy, must be secured in the general purpose animal, or there will be a tendency for some single quality to predominate.

A tendency to the expenditure of energy in one direction during the period of growth, and in another direction when maturity is reached, may be cultivated and fixed by heredity. This principle is an important one for consideration in breeding dairy stock. When a cow is giving milk the tendency, or inherited habit of the organs of nutrition, may be to expend the entire energies of the system in the milk producing function, and when she becomes "dry," the available energy may be expended in laying on fat. The difficulty is, however, to maintain a due balance of the two functions. If the fattening tendency predominates, the period of giving milk may be shortened and the activity of the function ultimately diminished. One of the best precautions against this is to retain in perfection the milking type in the general form of the animal, and to keep up the milk secreting function as long as possible by proper management. Constant care in the selection and treatment of the animals will be required to secure the most desirable balance between the two functions, and prevent a predominance of either.

Exercise as a Factor in Improvement.

From the general principles already noticed, it must be seen that the exercise of special organs, and of the general system, are necessary to secure the highest excellence in the working of the animal machine. We must keep in mind the fact that the exercise of an organ or group of organs, involves an expenditure of energy, and what is spent in one direction can-

not be used in another, that is to say, that work performed by one organ diminishes the amount of energy to be expended in work by another. Judgment is, therefore, required to adopt the exercise, in a particular case, to the requirements of the system for a special purpose.

The general exercise of the muscular system is undoubtedly desirable in growing animals to secure the symmetrical development of all organs, or parts of the body. Even in the process of growth a bias, or tendency to the expenditure of energy in a particular direction may be encouraged. This is illustrated in the Palo Alto training of youngsters. Culture and heredity have given the remarkable development of the trotting horse, and early culture, or training, is now looked upon as one of the most encouraging factors in future improvement.

In the animal raised for meat production, early maturity is essential, and the tendency to flesh forming may be encouraged from birth. Exercise of the general system in the early stages of growth should tend to promote the development of muscle, or lean meat, and check the tendency to excessive fat production.

While recognizing the advantages of muscular exercise during growth, in promoting the formation of lean flesh, and a symmetrical development of the system as a whole, we must not overlook its unfavorable influence under other conditions. In the case of a cow giving milk, or in that of a fattening animal, muscular exercise must result in a diversion of energy from the work of milk production or flesh formation. Any considerable amount of muscular exercise by a cow giving milk must tend to diminish both the quantity and quality of the milk produced, or at least diminish the total amount of the solid constituents of the product.

Quality of Milk and Energy.

A large mess of milk may be produced with but a small quantity of solids, and a corresponding small expenditure of energy. The best milk contains very much more potential energy than poor milk, and it must cost a corresponding expenditure of energy to produce it. In other words, more

work is done by the animal machine in making good milk than in turning out an inferior article containing a larger proportion of water.

Sex Influencing the Transmission of Hereditary Characters.

From the manner in which pedigrees are recorded in some of the herd books, there is a tendency to overlook the characteristics of the female ancestors, which, especially in the dairy breeds, are of great importance. In the chapters on "atavism," and "the relative influence of parents" in my "Stock Breeding," a number of cases are collected showing that sex has an influence on the transmission of characters. A sexual alternation in the inheritance of dominant characters is often observed, female peculiarities being more strongly transmitted to male offspring, which they in turn impress upon their female offspring; and male characters are in the same way transmitted by females. This should not be overlooked in breeding dairy stock, as the milking qualities of the grand dam frequently appear to be transmitted to her grand daughters with greater intensity, and certainty, by her sons than by her daughters. The female ancestors of the bull in a dairy herd must, therefore, be of especial interest in his pedigree, as an index of the qualities he will be likely to transmit as dominant characters to his daughters.

The means of improving animals in useful qualities may be expressed in a few general principles, and the success of the breeder will depend upon their judicious application under the circumstances presented in each particular case, and every detail of practice must conform to them to secure the best results.

The most valuable qualities of our domestic animals are the outcome of highly artificial characters, representing a wide departure from the original stocks from which they sprung; and if the same artificial conditions that produced them are not maintained, and the selection of breeding stock is not limited to the animals that have the desired characters, they are

readily impaired and finally lost. The old race characters, under careless management, have an advantage over the more unstable acquired characters that give the animal its greatest value.

Pedigrees must be studied to ascertain whether all ancestors have had the desired qualities. Cross breeding, in the widest sense of breeding together animals of distinct breeds, would not now be defended by any intelligent breeder, but the same principle is frequently acted upon in breeding together different families of the same breed, and unless there is a strong prepotency on the one side, the advantages of such crossing must be at least problematical.

Uniformity in hereditary characters, so far as we know, can only be secured by breeding together animals having the same characteristics.

The whole matter of successful breeding may be summed up in the two words "culture" and "heredity," and in the selection of breeding stock it is desirable that all ancestors should have had the required form of culture, or training, in order to secure uniformity in hereditary characters.

THE MEANING OF TREE-LIFE.

By Henry L. Clarke.[1]

(*Continued from Volume 28, page 472*).

It is a striking fact that the older fossil forest remains, at least through the Paleozoic and early Mesozoic strata, present a wonderful likeness in character the whole world over. The wide scattering and spreading of types that this indicates, is to be directly accounted for partly by the more frequent physical changes that took place in early geologic times, and the constant changes and shiftings in the relative positions of continental surfaces, through upheavals and subsidences; and in part by the wide wind-dispersion possible for the spores of the Paleozoic Cryptogams. Past question geology makes countless blunders in assigning strata in different parts of the world to the same age because of likeness in their fossil flora (and the statement holds almost equally true of fauna), where likeness is in fact a positive proof that the strata are not synchronous. But the chances for error in this direction decrease from the latest to the most remote ages. All evidences indicate more and more homogeneous climatic and physiographic conditions as we trace the geologic record farther and farther back.

When the low insular character of the early continents, and the consequent increased humidity of the atmosphere extended a nearly sub-tropical climate to the poles, it is obvious that the potency of the sun as a maker of the seasons and and zones, counted for far less than now,—unless indeed the sun itself were tremendously hotter then than now. But that this last supposition is false within the history of vegetation is proven by a simple fact. Were it true, the equatorial zone would have been a region of such intense heat that it would have formed an impassable barrier between the floras of the

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north and south polar regions; whereas, on the contrary, we find identical types to the far corners of both hemispheres.

It is a vitally important consideration that a slight increase in general atmospheric humidity would have the effect of converting the atmosphere into a heat-distributing oven.

We cannot indulge in the absurdity of asserting separate centers of identically similar development, and we know that the torrid zone of even the present would be impassable to perhaps 99% of our far north temperate flora; so here is proof sufficient of relatively great homogeneity in the conditions of the far past, and increasing heterogeneity thence down to the present. Aside from the greater stability and ruggedness of modern continents, the change that has wrought an all important effect upon vegetation, has been the development of the modern widely extended continental land-areas, producing a secular diminution in the general humidity of the earth's atmosphere, with the consequent full development of the great climatic zones, the polar, temperate, and torrid. Probably in the later Mesozoic and early Tertiary, this change began to make its influence most strongly felt, and through the Tertiary down to the present its effect has steadily and rapidly become more and more obvious. The fact is of course not to be lost sight of, that the highly specialized Mesozoic and Tertiary floras would be far more susceptible than the more lowly Paleozoic to climatic changes. But the working of these changes has been all-powerful in making most of the problems of geographic botany that are before us in the present, and so we may here fittingly turn the course of our discussion in this direction.

The progressive changes from the comparative homogeneity of conditions in remote ages to the world-wide heterogeneity of the present, have been recorded in the development of more and more complex tension systems between the various factors of vegetation. Of these systems, the most primitive was that belonging to each individual forest,—a central stronghold of old established types, merging into a tensional margin line of newer, weaker forms. Wherever vegetation existed, this tension system must have existed; but while we see it in the

present world under an indefinite variety of aspects, probably in Paleozoic times a study of the tensions of one forest would have been, in the main, a study of all others. The far more homogeneous climatic and physiographic conditions then prevailing, must have meant almost as striking world-wide similarity between all forest tracts, as there is now bewildering diversity. New forms were far more rapidly dispersed from the localities where they originated, and wherever they migrated they found conditions practically similar and hence equally favorable. Thus within a comparatively brief range of time, closely similar floras might have been found in widely separated regions. But another factor came into play at an early period to greatly complicate the problem—the physiographic irregularities in continental surfaces. The increasing stability of physiographic features from remote toward modern times, has made these features vastly more complicated and diverse now than in ages past, and consequently their influence on vegetation has become more and more profound. The earliest, as well as all the subsequent manifestation of this influence, was the development of a second great system of tensions—tensions between the unlike vegetations of adjacent unlike country surfaces, between the swamp and the dryer plain, the flat country and the hills, the mountain sides and the valleys. Here the tensional margin lines of two diverse hosts of vegetation met and formed another tension line between their own, and on this, the struggle for the mastery waxed fiercest, and the evolution of highly specialized forms was most active.

Such were the two tension systems of preeminent importance in the early history of plant-life; later a third came upon the stage, brought into existence through the development of the great climatic zones. Probably this first began to assume decided importance, as has been pointed out, sometime in the later Mesozoic, and increased the range of its influence through the Cretaceous and Tertiary, till in modern times, it has culminated in producing the broadest and most fundamental division of the world into great botanical realms. That there were regions of glacial cold in Australia, India, and Cape Colony in Carboniferous times is an undoubted fact;

that there were regions of glacial cold in previous, as well as several subsequent, ages is highly probable; but this does not invalidate the general principle suggested here. The reconstructive meteorology of the near future will probably demonstrate that the geographical distribution ot the Carboniferous glaciation, and of several other similar cases, is directly connected with peculiar stages of continental evolution and oceanic extension. And while such glaciations are of far-reaching importance for their age, they are nevertheless temporary "perturbations" that do not, in the long range of time, break down the secular increase in the direct subordinating of the zonal world-climate to astronomical, rather than terrestrial, influences. From a nearly homogeneous climatic condition throughout the world, there were gradually developed five fairly distinct zones merging into each other at their adjacent margins—a torrid equatorial, frigid polar, and temperate intermediate. Their development inevitably had a profound effect on vegetation. In the fossil forest beds of Cretaceous times in far northern regions, there have been found side by side Cycads, Conifers, Palms and Hardwood trees, a conglomeration utterly bewildering to the botanist of to-day, but nevertheless a typical indication of the relatively homogeneous climatic conditions of the age when such a forest could have existed.

With such a suggestion of the Mesozoic world before us, let us watch the great climatic zones develop. It is the tree-life of the forests that tells the story most clearly; to it belonged preeminently the all-important mission of remodeling the aspect of the world's vegetation. The trees moved their habitats, and the herbaceous forms were carried along with them. In the equatorial belt were all the conditions of heat and moisture most favorable to the vigorous development of plant life; in the polar regions that sternest foe, steadily increasing cold; in the temperate belts, a compromise between the conditions of the others. From the original mixed forest a selection had to be made of the tree-groups that were to hold dominion respectively over each of the new sets of conditions. How? It will not do to say glibly, the Palms

loved the heat, the Conifers the cold, and the Hardwood trees the happy medium. Conifers luxuriate to-day in the torrid zone, and Hardwood trees and modern congeners of the Palms once grew together in Greenland. No innate partiality for heat or cold separated the three great groups, but the stern laws of plant dynamics that determine the course of the struggle for existence. The old established and all-powerful tree-group, the patriarchs of the forest, were the Conifers, the group best fitted to stem the tide of change and battle with opposing conditions; next them in power, because most like them in character, were the Diclinae; and weakest were the Palms, the group whose foot hold was most precarious. These last could hold their own against the powerful Conifers and Diclinae only so long as climatic conditions were most favorable. Consequently, as the cold advanced from the polar regions the palms retreated toward the torrid zone. Here they took their stand, their highly specialized structure asserted its full power, and gradually they crowded out the Conifers and Diclinae, and established preeminent dominion over the equatorial belt. The Diclinae and Conifers were crowded out, "not that they loved heat less, but that they loved freedom more." They were fitted to maintain themselves against the cold of extratropical regions, and in these regions they were relieved from the struggle with a powerful competitor, the whole family of Palms and its associated rank luxuriance of tropical vegetation. In short, the strength of the Palms when congested into the equatorial belt, more than counterbalanced the loss sustained by the coniferous and hardwood trees in the cooling of extra-equatorial regions. And so the Palms, and with them the remnant of their ancient allies, the Tree-ferns and Cycads, claimed the tropics for their heritage. There was probably no region of the world where Conifers had not gained a strong foothold in the long course of ages; there is scarcely a corner of the modern plant-world that does not hold some group of them; and it was the Coniferæ that obstinately held their own against the cold of sub-polar lands, with the stubborn endurance that four great eras of geologic time have helped to build.

The Diclinae retreated before the advancing cold into more temperate climes, retreated in fact until they gathered strength to wage equal battle with their mighty coniferous opponents.

Here, in the temperate zones, the Diclinae stood fast and crowded the Conifers outward toward the polar regions, not toward the equatorial, for there the odds againt the emigrants would be tenfold increased. The record of this battle of the trees is stamped upon many of the forest monarchs that we marvel at to-day. A recent writer has well said: "Just as in the formidable armor of some extinct armadillo one may read somewhat of its struggles with its enemies, so in the one hundred meters of solid trunk and in the massive girth of a living Sequoia gigantea, the giant red-wood, one may learn of its struggles in the ancient forests of Cretaceous and Tertiary times, when its allies and competitors were alike more numerous."

The third great tension system is now unfolded before us. We see the hardwood forests of temperate regions facing on the one hand the congested luxuriance of equatorial vegetation, and on the other the ancient coniferous forest gathered round the poles and step by step forced backward by advancing cold. There is a great equatorial pressure toward the poles, and an opposing polar pressure, traceable to opposite causes; and between them there is a broad tension line, the temperate zones. Conway MacMillan, who was quoted just above, has proposed a broadly generalized division of the world into two great botanical realms, the Central Realm and the Distal Realm. But the division should be carried a step farther; taking the three great forest elements as a guide, we may fully express the evolutionary history of plant dynamics by recognizing three great divisions:—

The Central Tropical Realm, the Tensional Temperate Realm, the Distal Sub-Polar Realm. The three merge into each other and their elements are everywhere somewhat commingled, but in the main they are fairly distinct. Such was the general plan of the plant world of the late Tertiary, proximate Preglacial times. The Glacial Period had a wonderfully interesting effect in modifying the northern

portion of it. The story has been often told, but one aspect of it will deserve further attention. Out of the various forests of north temperate regions, we may recognize four that are of peculiar interest. The European, the Northeast Asian, the Appalachian, and the Pacific North American. All are relics of the preglacial northern forest, but they are relics in very different stages of preservation. The Northeast Asian is a marvel to students of tree-life in the abundance and immense variety of its forms. Evidently it has best preserved the characters of the primaeval forest. The poverty of the European forest is equally striking and has been well explained by the fact that the east and west mountain chains and the Mediterranean to the south were fatal to the vegetation retreating before the advancing glaciers. The Atlantic North American, or Appalachian forest, on the contrary, was well preserved by the physical characters of the country, and in its perfection is second only to the Northeast Asian. But the Pacific North American is an anomaly. It is preeminently a forest of Conifers with an astonishing poverty of hardwood types, although the latter are abundant as fossils in the Tertiary strata of the region. But is this such an enigma as it has often been considered? The ice sheet that swept over the Great Lakes and down into the Mississippi Valley did not reach that Pacific forest region of the United States, but its influence was felt there none the less surely. Before it retreated—first the Hardwood forest, and close on its heels the Coniferae. The Coniferae invaded the strip along the western slope of the Rockies, and also the great Northeastern Asian forest region, and remained in both, about equally strong in number of species. But in the case of the first named region what became of the Hardwood forest that pushed ahead of the Conifers? Behind it on the east were the Rockies; before it on the west the Pacific; and to the south the stern physiographic obstacles of the Mexican coast. And again, what was the character of the coniferous forest that invaded the Pacific strip? We need only point to the two Sequoias, sempervirens and gigantea, the "Big Trees" of California, the culminating triumphs of vegetative energy in Coniferae. The

Pacific strip became the refuge and stronghold during glacial times of the mightiest phalanx in the North American coniferous forest, and there they have stayed, simply because all competitors perished before their invasion. Obviously the conditions in the case of the Asian coniferous invasion were vastly different; while the comparative poverty of the coniferous element in the Appalachian forest is directly traceable to the strength of its hardwood element and the path of retreat afforded the Conifers toward the north and northwest.

A remarkable example of the development of higher types along the tensional margin-line was the glossopteris flora of the Carboniferous glacial regions,—a flora an age ahead of that of the rest of the world, and developed where the latter flora was beaten back by the glacial cold.

Many details of great interest to the systematic botanist might be outlined in this connection, but what has been suggested suffices to show how vitally important is the chapter of plant-history recorded in the world's tree-life. It will be found on comparison, that the record of the development and migrations of shrubby and herbaceous plants closely accords with the history of the tree-groups with which they are most closely allied. But the stability of tree characters vastly exceeds that of the characters of the lesser plant forms, and hence it is these latter that vary most in passing from one region to another. Still in this latitude we may clearly observe that the more ancient herbaceous forms are the more northerly in their range, and the newer the more southerly. The equatorial belt has become the great center of developmental activity, and out from its congested tension-margins come the vanguard of our highest floral types. The coniferous trees were all-powerful in the Mesozoic; the Hardwood trees of the amentaceous and choripetalous Dicotyls seem to have reached a climax of luxuriance in the late Tertiary; and out of the great element of sympetalous Dicotyls that predominate the herbaceous flora of the present world, there may be developed another great tree group that shall rule the forest of the far off future. The promise of this last is already to be found in the arborescent Compositæ of certain of the Pacific

islands. But it is certain that forest development in the future will follow no such clearly defined courses as in the past; the wonderful complexity of the geographical botany of the present has forever sealed the possibility of another distinctive tree-group attaining such a world-wide prominence as either the Conifers or the Diclinae or the Palms. These three must stand alone as a unique monument to the struggle for existence in the primaeval Mesozoic forest. For even as the conditions of that age made possible a remarkably homogeneous plant world, even so the great tension system of the earth's present vegetation makes diversity, to an equally or more remarkable degree, the key-note of future development.

LEPIDOSIRENIDS AND BDELLOSTOMIDS.

By Theodore Gill.

I.

In the American Naturalist for November, 1893, Dr. Howard Ayers has published an article " on the genera of the Dipnoi Dipneumones" which exhibits a characteristic—" lumping "—which, may sometimes be a virtue but which, in this particular instance, has been exaggerated into a decided fault.

In 1885, Dr. Ayers created much astonishment among naturalists familiar with the history of the Lepidosirenids by not only refusing to admit the generic differentiation of *Lepidosiren* and *Protopterus*, but by contending that the representatives of the two genera were even *specifically inseparable*, and that the American habitat of the type was doubtful!

In the article just cited, Dr. Ayers has given a reluctant and grudging admission to specific rank of the two types but has unqualifiedly denied their higher rank; grudgingly, because he concludes that " if they had to be named as new discoveries to-day, and could be studied together in so doing, most zoologists would include both animals in one genus, *even if they did not group them as varieties of one species* " (p. cit., p. 922).

Dr. Ayers' former article has been sufficiently answered by Baur, Schneider, and Parker, and his last article fails to invalidate their contentions. I shall only add that, after a comparison of the entire body as well as the skeleton of *Protopterus annectens* with the descriptions and figures of the corresponding parts of *Lepidosiren paradoxa*, I am convinced that no zoologist of mature experience would hesitate to rank *Lepidosiren* and *Protopterus* as *very distinct genera.*[1]

[1]Professor Ray Lankester, in "*Nature*" for April 12, 1894, (p. 555), has announced that he recently obtained, "by purchase from a London dealer, specimens of the Lepidosiren of the Amazon well preserved in spirit" (how many he has not told). He has illustrated peculiarities in "the limbs of *Lepidosiren paradoxa*," and we may soon expect more details from that accomplished naturalist.

II.

In the article in the NATURALIST (p. 923), Dr. Ayers claims to " have ascertained that, taking all the *Bdellostomids* together, they form a series in which the gill variation runs between the minimum of 6 pairs and the maximum of 14 pairs, or a DIFFERENCE BETWEEN THE EXTREMES OF 8 PAIRS OF GILLS, AND YET ALL THESE INDIVIDUALS NOT ONLY BELONG TO THE SAME GENUS—THEY BELONG TO THE SAME SPECIES ! " (Big type and exclamation mark are Dr. Ayers' own).

In " Biological Lectures " delivered at Woods Holl in 1893, lately published, is reproduced (pp. 125–161) a lecture by Dr. Ayers on " *Bdellostoma dombeyi* Lac.; A study from the Hopkins Marine Laboratory." Therein Dr. Ayers has urged at length the contention just cited and has categorically stated that " the number of gills of individuals from *different localities* varies from 6 on either side to 14 on either side, with the observed intermediate stages " (p. 137).

Dr. Ayers' own record of his observation (p. 140) and summary of those of his own as well as of others (p. 156) will be an all-sufficient refutation of this claim.

" In the material which [he] was able to collect at Monterey, the following proportions of the several variations prevailed :

104	individuals	had	11	gills	on	both sides.
26	"	"	11	"	"	one side.
		and	12	"	"	the other side.
208	"	had	12	"	"	both sides.
11	"	"	12	"	"	one side.
		and	13	"	"	the other side.
8	"	had	13	"	"	both sides.

354 total number of individmals counted."

In his summary of observations on the number of gills, he gives formulas for all observations as follows :—

"*Bdellostoma dombeyi* 6 gills.

"	"	6–7	indicating the sides of the body upon which the respective numbers occurs.
"	"	7–6	
"	"	7	
"	"	10	
"	"	11	
"	"	11–12	
"	"	12–11	
"	"	12	
"	"	12–13	
"	"	13–12	
"	"	13	
"	"	14"	

It will be noticed that there is a great gap from 7 to 10 which has been straddled, but for which there is not the slightest observational basis. The logical fallacy involved is too obvious to need more than pointing out.

On one hand out of 354 specimens examined by Dr. Ayers, 208 had 12 pairs of gills and 104 had 11 pairs of gills, while 26 had 11 *or* 12 on one side. Not a single one had less than 11. No specimen with a smaller number than 10 has been recorded from the Pacific Coast.

On the other hand, of many specimens obtained in New Zealand, South Africa, etc., all had 7 or 6 and none had more.

Are not these facts sufficient to prove the distinctness of the two types?

(1) There is a gap of from 7 (maximum) to 10 (minimum) at least, between the number of gills of the two types. (2) The range of variation, considerable as it is, is limited in both directions. (3) The differences in numbers are associated with differences in geographical range. Certainly, then, the two forms are specifically distinct. Are they not generically distinct?

Dr. Ayers has truly remarked (p. 152) "It seems to have become a settled belief among the large majority of zoologists of both morphological and systematic proclivities, that the number of gills found among vertebrates never rises above

eight pairs in existing forms." The deviation from this almost universal rule led me to propose the generic differentiation of "*Bdellostomids* with an increased number of branchiæ" from those "with typically 7 (sometimes 6)." Be it recalled also that the former have "the base of the tongue between the seventh or eighth pairs of gills," while the latter have "the base of the tongue between the anterior pair of gills."[2] The genera thus defined were named by me *Polistotrema* and *Heptatrema* (Proc. U. S. Nat. Mus., 1882, pp. 518, 520). These have been accepted by Jordan, Gilbert, the Eigenmanns, and others, and probably will continue to be. Dr. Ayers, however, has urged that "these accounts all refer to the varieties of what I shall call *Bdellostoma dombeyi*, adopting Müller's genus on account of the inapplicability of Lacépéde's *Gastrobranchus*, and of the inappropriateness of Cuvier's *Heptatremes*, which could only be used for the seven-gilled form or variety" (p. 155).

Gastrobranchus was a generic name formed for *Myxine* alone and of course could not be perverted to a *Bdellostomid*. *Heptatrema* can be used for the group to which it was applied with perfect propriety, even though the species deviate in having often 6 branchial apertures on one or both sides. A corresponding latitude of usage is so generally recognized by modern zoologists, that a defense of such procedure is unnecessary. Even if such an extreme view prevailed, however, there is the name *Homea* of Fleming available, and this was proposed many years before *Bdellostoma*.

There are several other questions that deserve attention, but I resist the temptation to consider them now.

[2] "The relation of the tongue muscle to the gills is of interest, and here again we find great variability. Müller found it to lie entirely in front of the gills in the 6 and 7 gilled forms from the Cape of Good Hope, and this condition obtains in *Myxine* so far as known. In *Bdellostoma* with 10 or 11 gills, the base of this muscle may lie between the 6th and 8th pair of gills according to Putnam. In the 12 and 13 gilled forms, I have found it between the 5th, or at most, the 6th pairs of gill-sacks." (Ayres, p. cit., p. 139, 140). No observational basis has filled the great gap between the "front of the gills" and the interspace between the 5th pair!"

THE ORIGIN OF PELAGIC LIFE.

(FROM PROF. W. K. BROOKS.)

Chapters VII and VIII of Brooks' Memoir on Salpa embrace a discusssion of this genus in its relation to the evolution of life, and in order to clearly present its position and significance in the economy of nature the author discusses at some length the conditions under which oceanic life has been evolved. He notes first that the marine animals are almost exclusively carnivorous. They prey upon each other to an almost incredible extent, and were it not for the extraordinary fertility of pelagic organisms the rapacity of the higher forms of life would bring about their own extermination. Mr. Brooks, in commenting on the abundance of marine life, instances the great schools of mackerel, the hunters of herring, which in turn swarm like locusts. In 1879, three hundred thousand river herring were landed by a single haul of the seine in Albemarle Sound; but the herrings feed upon copepods, each one consuming myriads every day. In spite of this destruction and the ravages of armies of medusæ, siphonophores and pteropods, the fertility of the copepods is so great that they are abundant in all parts of the ocean, and not only on the surface, for banks of them are sometimes a mile thick. On one occasion the Challenger steamed for two days through a dense cloud formed of a single species. But upon what do the copepods feed? And this brings the author to the important factors in the food supply of the animals of the ocean. The basis of all the life in the modern ocean is to be sought in the microorganisms of the surface. They consist of a few simple unicellular plants, and the globigerinæ and radiolaria which feed upon them. These organisms are so abundant and so prolific that they meet all demands made upon them. They are not only the fundamental food supply, but, according to the author, the primæval supply which has determined the whole course of the evolution of marine life.

Sameness of environment and lack of competition for space have tended to make pelagic plant life retain its primitive simplicity, but existing apparently under the same conditions is an infinite variety of animal life. How can this be accounted for? In tracing the phylogeny of Salpa, Mr. Brooks finds that the structure which is so well adapted for life on the high seas has come to it by the inheritance of peculiarities originally acquired by bottom animals in adaptation to the needs of a sessile life. In this connection the author states that the majority of the present pelagic animals have not been produced at the surface of the ocean by gradual evolution from a simple pelagic ancestor, but that part of their family history has been worked out by individuals who colonized upon or near the bottom, or along the sea shore, or upon the land, and the exceptions are all simple animals of minute size. He reviews the chief groups of metazoa to demonstrate this fact and gives, as notable exceptions, some of the veiled medusæ, a few of the primitive annelids, possibly, and the copepods among the crustacea. Among the higher forms, the fishes, which at first sight would seem to have been pelagic from the beginning, so admirably are they fitted for life in the open water, are found upon examination to be only secondarily adapted to a pelagic life, like the sea-birds and the cetaceans.

Mr. Brooks bases these statements on evidence from paleontology, from embryology, and from the structure and habits of living animals.

In discussing the conditions under which the primitive pelagic fauna lived, and the comparative results of pelagic and bottom environment upon marine life, the author points out that while the animals which first settled on the bottom probably did not secure more food than did their floating allies, they obtained it with less effort and were able to devote their surplus energy to growth and multiplication. The rapid multiplication led to crowding and competition, prevented the influx of newcomers from the open water, and finally resulted in the elaboration and specialization of the types of structure already established. Evolution was rapid, for life at the bottom

introduced many and new opportunities for divergent modifications.

Another result was the escape of varieties from competition with their allies by flight from the crowded bottom to the open water above. The influence of these emigrants upon strictly pelagic forms is seen in the evolution at the surface of complicated forms like the siphonophores. But, on the whole, ocean space is so great and conditions of life in open water so easy that many of the pelagic organisms retain their primitive simplicity, existing simultaneously with the large and highly organized invaders from the shore and bottom.

The colonization of the bottom formed an important era in the evolution of marine life and the author devotes a section to a consideration of the characteristics of this primitive fauna of which the following is a summary:

"1. It was entirely animal, and it at first depended directly upon the pelagic food supply.

"2. It was established around elevated areas and in water deep enough to be beyond the influence of the shore.

"3. The great groups of metazoa were rapidly established from pelagic ancestors.

"4. There was a rapid increase in the size of the bottom animals and hard parts were quickly acquired.

"5. The bottom fauna soon produced development among pelagic animals.

"6. After the establishment of the bottom fauna, elaboration and differentiation among the representatives of each primitive type soon set in and led to the extinction of the connecting forms."

In comparing these characteristics with those of the earliest known fauna as sketched by Walcott, Mr. Brooks finds that in going backward toward the lower Cambrian he finds a closer and closer agreement with the biological conception of the primitive life at the bottom. And while he does not regard the Olenellan fauna as the first bottom fauna, since it contains forms secondarily adapted to pelagic life, such as pteropods, still, "a biologist must regard it as an unmistakable approximation to the primitive fauna of the bottom, beyond which

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life was represented only by simple and minute pelagic organisms."

Mr. Brooks' point of view, then, is that marine life is older than terrestrial; it has shaped itself in relation to its food supply; this food supply, the microorganisms referred to above, is the only form of life which is independent and it therefore must be the oldest; from these simple types the pelagic ancestors of all the great groups of metazoa were slowly evolved until the colonization of the bottom, when a rapid advancement took place; the present highly differentiated forms which constitute the ocean fauna are the descendants of the colonizers, while the lower pelagic forms are the lineal representatives of the primitive forms, some of which are slightly modified by the influence of the emigrants from the shore and bottom.

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STEARNS, R. E. C.—Notes on Recent Collections of North American Land, Fresh-water and Marine Shells received from the U. S. Dept. Agri. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

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WILLIAMS, G. H.—The Distribution of Ancient Volcanic Rocks along the eastern border of North America. Extr. Journ. Geol., Vol. II, 1894. From the author.

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RECENT LITERATURE.

Gage's Microscope and Microscopical Methods.[1]—Some years ago we noticed one of the previous editions of this work, prepared for the use of the Students of Cornell University. The present, the fifth edition, is greatly enlarged and forms a most valuable guide to the microscope as an optical instrument, showing the use of each part, the means of testing and using it, correcting its faults, etc. Following this portion comes some more special directions for its use in spectroscopic and polariscopic work and in photography, together with a chapter on the mounting of slides in which every aspect of the subject, from the measuring of the thickeness of the cover glass to the labelling and storage of the slides is discussed, excepting that the staining and sectioning of the specimen is left for a second part which is announced as in preparation. This second part will deal with the use of the Microscope in Vertebrate Histology, and with the two volumes the student will not often meet with questions of technique in this line which cannot be answered by referring to this vade mecum. The work is well printed and is a credit to Comstock Publishing Company which issues it. It is well illustrated with 103 cuts while the fact that every other page is left blank, allows the student opportunity to add notes. The work will doubtless be used in many other laboratories than that for which it is especially preparared.

Shufeldt on Chapman's Birds of Trinidad.—To the Editors of THE AMERICAN NATURALIST:

DEAR SIRS:—In your issue for April, 1894, p. 332, I find a review of a paper by me on Trinidad birds in which, much to my surprise, the reviewer charges me with an attempt to place all but Passerine birds in the order Macrochires! I had intended in this paper to give the names of the sixteen orders which have representatives in the Trinidad avifauna, and under each order the families which most Ornithologists now believe to belong in it. In a vain endeavor, however, to hurry my paper through the press before sailing on a second voyage to Trinidad, the last half of the copy was unfortunately sent to the printer before the slips giving the names of orders and families had been

[1] The Microscope and Microscopical Methods by Simon Henry Gage. Ithaca, 1894, pp. viii, 165.—$1.50.

inserted. I did not see proof and the error was noticed too late for correction.

The fact that not only the names of orders but also those of *families* are wanting after "Macrochires" and "Trochilidæ," should, I think, have suggested to so practiced a reviewer that there was a *lapsus* somewhere.

It is certainly bad enough to be accused of trying to classify all but the Passeries in one order, but when it logically follows—and in this case it does—that one is also accused of attempting to crowd the same heterogeneous assemblage into the family Trochilidæ I must, in justice to myself, plead not guilty.

Very truly yours,
FRANK M. CHAPMAN.

American Museum Natural History, New York City. May 24, 1894.

Annual Report Minnesota Natural History Survey for 1892.[1]—The important papers incorporated with this report are as follows: The Geology of Kekequabic Lake with special reference to an augite-soda granite, by Mr. U. S. Grant; Report of a reconnoisance in northwestern Minnesota in 1892, J. E. Todd; and Field Observations of N. H. Winchell in 1892. A feature of general interest is a table of comparative nomenclature prepared by the State Geologist. This table gives the Minnesota Strata in order; the stratigraphy of the Wisconsin reports issued under the direction of Prof. Chamberlain; the terms used by the present Michigan survey; and the general terms used by the United States and Cananian geological surveys. These separate series are arranged so that one can see at a glance the supposed equivalents.

[1] The Geological and Natural History Survey of Minnesota. The Twenty-first Report, for the year 1892. N. H. Winchell, State Geologist. Minneapolis, 1893.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Schlosser on American Eocene Vertebrata in Switzerland.[1]—Dr. Max Schlosser has recently[1] reviewed the work of Prof. Rütimeyer of Basel on the "Eocene Fauna of Egerkingen." In this memoir Dr. Rütimeyer endeavored to show that there have been found on the Eocene bed of Egerkingen, Switzerland, certain genera of Mammalia which were previously discovered in North America, and had not been known from any part of Europe up to that time. These fossils he named as follows.

Tillodonta. *Calamodon europœus.*

Quadrumana. *Hyopsodus jurensis; Pelycodus helveticus.*

Condylarthra. *Phenacodus europœus; P. minor; Protogonia cartievii; Meniscodon pictetii.*

Dr. Schlosser makes the following critical observations on these species.

He considers the *Calamodon*[2] *europœus* to be well established.

Hyopsodus jurensis is probably an Artiodactyle allied to Dichobune. The *Pelycodus helveticus* is a lemuroid, but of a genus different from Pelycodus. *Phenacodus minor* is probably a Creodont, while the *P. europeus, Protogonia cartierii* and *Meniscodon pictetii*, Dr. Schlosser thinks belong to a single genus, which he thinks is Protogonia (Euprotogonia). He doubts whether the teeth, on which the three species are founded, belong to distinct species.

As a result Schlosser concluded that Rütimeyer in correct in determining the American genera Calamodon (Conicodon) and Protogonia, (Euprotogonia) as occurring in the Egerkingen formation. The lemuroids and creodont are of types common to both continents, while the Dichobunid is European in relationship.

Schlosser further remarks, that a boreal fauna, such as exists at present, was unknown during the Cenozoic ages. Europe was the home

[1] Zoölogischer Anseiger, 1894, no. 446, p. 157.

[2] A genus of birds has been named Calamodus, a name which is in my opinion abundantly distinct from Calamodon. As, however, there are persons who, like the American Ornithologists Union, will make this resemblance an excuse for changing the name, I suggest that they call it Conicodon, from the shape of the molars, as distinguished from those of Stylinodon.

of the Artiodactyla except Oreodontidæ and Tylopoda, of the true Carnivora, and the Monkeys (except the S. American). North America was the home of the Perissodactyla and Amblypoda, and the ancestors of the monkeys and carnivora, during that time.

The Skull of Pisodus owenii.—It is now a well-established fact that many types of Teleostomous fishes have undergone very little change since the Eocene, or even since the latter part of the Cretaceous period. Several well-defined genera seem to date back thus far, and others are represented by forms that differ in but small particulars. Moreover, a few of the most remarkable specializations in piscine skeletal anatomy chatacterizing the existing fauna are already recognizable in certain closely related Eocene types, and the progress of discovery is continually adding to the number of known examples. A most striking new case has been lately met with by the present writer among the fishes from the London Clay (Lower Eocene), and this forms the subject of the following notes.

So long ago as 1845, Sir Richard Owen described and figured the tritural dentition of an unknown fish form the London Clay of the Isle of Sheppey under the name of *Pisodus oweni* (ex. Agassiz MS.). The original specimen is preserved in the Museum of the Royal College of Surgeons, and exhibits an ovate pavement of small rounded or polygonal teeth firmly fixed in shallow sockets upon a plate of true bone. Appearances suggested to Sir Richard Owen that the fossil had been attached to another bone of the skull, most probably, as in Glossodus and Sudis, to a median bone of the hyoid system. Agassiz, who first examined the specimen, supposed it might pertain to a so-called Pycnodont Ganoid; and in Owen's Paleontology (edit. 2, 1861, p. 174) Pisodus is also doubtfully quoted as a "Ganoid" of uncertain position.

It now appears from a nearly complete skull in the British Museum that the problematical fossil in question is the parasphenoid dentition of a fish remarkably similar in cranial characters to the recent Clupeoid Albula. The fact has already been incidentally mentioned in a record of the discovery of Pisodus in the Middle Eocene of Beligium; and it only remains to justify, by a detailed description and figures, the recognition of an Albula-like fish at so remote a period as that of the Lower Eocene. Dr. Shufeldt's admirable description of the skull of the recent *Albula vulpes* fortunately suffices for requisite comparison. (Dr. Smith Woodward in Ann. Mag. Nat. Hist. Ser. 6, Vol. XI, 1893.)

Geological News, Cenozoic.—In studying the origin of Lake Cayuga, Mr. R. S. Tarr, has become a convert to the rock-basin theory of lake formation. In a paper recently published he shows that the preglacial tributaries to the Cayuga valley are rock enclosed and that their lowest points are above the present lake surface. This the author holds to be proof positive that Lake Cayuga is a rock-basin. If this be true, a similar course of reasoning would suggest that Lake Ontario is also a rock-basin, from the fact that the preglacial Cayuga River flowed north and was tributary to a river which drained Ontario, and whose channel was above the present surface of the lake. (Bull. Geol. Soc. Am., Vol. 5, 1894.)

The recognition of the extension of the Pine Barren flora of New Jersey through Staten Island, Long Island, Nantucket, Southern Rhode Island, and Massachusetts, suggests to Mr. Arthur Hollick a theory of a continued existence of land connection between New Jersey and southeastern New England, by way of Long Island, during a sufficient time after the final recession of the glacier, for the pine barren flora to have spread and become established there. This theory would seem to be supported by the position and configuration of the chain of islands to the east of Long Island Sound, and by the geological history of this region. If Mr. Hollick's views are correct Long Island, Block Island, Nantucket, Martha's Vineyard, etc., as we now know them, have not been snbmerged since the final retreat of the glacier, and their separation into islands is a comparatively modern phenomenon due to erosion, and the depression of the costal plain. (Taans. New York, Acad. Sci. Vol., XII, 1893.)

A new theory of the origin of Drumlins has been advanced by Mr. Warren Upham, viz.; they are the result of the accumulation of englacial drift. The author offers the following explanation of the manner of the accumulation. The upper current of the thickened ice above the englacial bed of drift would move faster than the drift, which in like manner would outstrip the lower current of the ice in contact with the ground. Close to the glacial boundary the upper ice must have descended over the lower part. This differential and shearing movement gathered the stratum of englacial drift into the great lenticular masses or sometimes longer ridges of the drumlins, thinly underlain by ice and over-ridden by the upper ice flowing downward to the boundary and bringing with it the formerly higher part of the drift stratum to be added to these growing drift accumulations. The courses of the glacial currents are not determined by the topography of the underlying land, but by the contour of the ice surface. (Proceeds. Boston, Soc. Nat. Hist., Vol. XXVI, 1893.)

MINERALOGY.[1]

Contributions to Swedish Mineralogy, Part I:—In this paper Sjögren[2] has given in English a very interesting series of crystallographical studies. The well known but rare axinite from Nordmarken is reexamined. In addition to the tabular crystals described by Hisinger and v. Rath's prismatic type, a third type of smaller crystals is identified having neither the tabular nor the prismatic habits and highly modified. Hedyphane which is closely related chemically to the members of the apatite group, particularly mimetite, has been supposed to possess monoclinic symmetry on the basis of Des Cloiseaux's determination in 1881. Sjögren has examined crystals from the Harstigen mine in Wermland and finds that both crystallographically and optically hedyphane is hexagonal. The crystals examined exhibited the forms oP, ∞P, P, $\frac{1}{2}P$, $2P$, $P2$, $2P2$, and clearly belong to the apatite group. Another member of the apatite group is discovered in Sjögren's new mineral svabite, which occurs in schefferite at the Harstigen mine. Svabite is a hydrous calcium arsenate of the composition indicated by the formula $HO\,Ca_5\,As_3\,O_{12}$ in which the hydroxyl appears to be part replaced by chlorine and fluorine. The mineral is crystallographically like apatite and exhibits the forms ∞P, P, $P2$, oP. The same mineral was found at Jacobsberg, enclosed in hausmannite. A very exhaustive study is made of the minerals of the humite group, all of which are found at Nordmarken. No less than 29 forms were observed on chondrodite from this locality, and these include the six new forms, $+\frac{1}{2}P$, $-\frac{1}{5}P$, $+\frac{1}{5}P$, $-\frac{3}{7}\bar{P}\frac{3}{2}$, $+\bar{P}2$, $-\frac{3}{11}\bar{P}\frac{3}{2}$. The humite of the locality showed 20 and the clinohumite 26 forms, all of which have been observed on Vesuvian crystals. A probable fourth member of the humite group which occurs at Nordmarken, is announced in this paper. Three new analyses of longbanite are contributed, on the basis of which the formula of the mineral is given as $m\,Sb_2O_3\,n\,Fe_2\,O_3\,p\,R^{IV}R^{II}O_3$ in which R^{IV}=Mn and Si, and R^{II}=Mn, Ca, and Mg. The symmetry of the mineral is shown to be rhombohedral, this and the chemical constitution indicating its isomorphous relation with hematite and ilmenite. Adelite is the name given to a new basic arseniate from Nordmarken, Jacobsberg and Longban, having the for-

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Bull. of the Geol. Inst. of Upsala, I; No. 1, (1892), pp. 1-64, pls. I-IV.

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mula 2CaO, 2MgO, H_2O, As_2O_5. The symmetry of the mineral is monoclinic and its relationships, both chemical and crystallographical, are with triploidite, wagnerite and sarkinite.

Optical Methods :—Friedel[3] has devised a new method for determining the double refraction in thin sections of minerals on the stage of the ordinary petrographical microscope. The method makes use of the quarter undulation mica plate. The nicols are crossed and the slide is raised a short distance above the stage on thin blocks, so as to allow of the introduction of the mica plate between the slide and the stage. The stage is now revolved until the directions of extinction make 45° with the principal sections of the nicols. The mica plate is introduced below the slide and carefully turned without moving the stage until that portion lying outside the mineral plate is extinguished. By now revolving the polarizer, the mineral can be extinguished or given the same illumination as the mica plate. The observations are made in monochromatic light. If the positive direction of the mineral plate passes through the upper right quadrant of the field and the positive direction of the mica plate coincides with the vertical cross hair, the polarizer should be revolved to the right, the angle φ required to produce extinction, and the angle φ_1 required to produce equal illumination of mineral plate and mica plate, yielding ψ the difference in phase produced in the mineral section. The formulas are $\psi=\varphi_1$ and $\psi=2\varphi_1$. The greater part of the paper is devoted to methods of evaluating errors in the process.

Harker[4] has determined trigonometrically the values of the extinction angle in prismatic cleavage flakes of augite and hornblende, as dependent on the optical angle and the extinction angle in the plane of symmetry. His tables of values will be convenient for reference, but as he points out, the variation in the values with 2V is not great enough to determine the optical angle from measurements of the prismatic and clinopinacoidal extinction angles.

Isotypism :—Rinne[5] compares crystals of the metals with crystals of their oxides, sulphides, hydroxides and haloid compounds. He points out that in this comparison we find strikingly close relationships between bodies markedly different chemically, and these relationships do not consist simply in identity of crystal symmetry, but in

[3]Bull. Soc. Franç. Minér., XVI; 19 (1893).

[4]Min. Mag., X (No. 47), p. 239.

[5]Neues Jahrb. f. Min., etc., 1894, (I) pp. 1-55.

close approximation to a type as regards crystal shape (Krystallgestalt) and interfacial angles. Even when the symmetry of two substances is not identical, he makes comparison of the crystal shape as, e. g., between a cube and a rhombohedron with polar edge approaching 90°. The author distinguishes seven types as follows: I regular type (isometric), II magnesium type (hexagonal and pseudo-hexagonal—orthorhombic), III arsenic type (rhombohedral), IV quartz type (hexagonal tetartohedral), V α tin type (tetragonal), VI rutile type (tetragonal and pseudo-tetragonal—orthorhombic), VII β tin type (orthorhombic and pseudo-orthorhombic—monoclinic). Every group but the fourth contains metals and this type Rinne considers as derivable from the third or arsenic type. Many oxides, etc., have their crystal forms to some extent indicated in the forms of their contained metals. The term isotypism is proposed to describe these crystallographical relations between members of different divisions of the chemical mineral system. The author further states, "It must now be accepted as a fact that such substances" (elements, oxides, sulphides, haloid salts, and even silicates, which have been grouped together under his various types) "possess equivalent or very similar crystal forms, and it follows that the chemical differentiation into elements, oxides, salts, etc., finds no crystallographical expression, and therefore no independent, certain conclusion as to the chemical group to which a compound belongs can be drawn from its crystal form."

Lamellar Structure in Quartz Crystals.—In an "additional note on the lamellar structure of quartz crystals and the methods by which it is developed," Professor Judd[6] describes and figures a remarkably beautiful instance of lamellar structure in quartz, in which he sees a close analogy with the "rippled fracture" which he finds can be produced in quartz crystals by breaking them in a powerful vice along a plane perpendicular to the optic axis. The appearance of such fractures is very much like that of "engine-turned surfaces." This appearance is caused by ridges following the planes R and -R, which are often curved and die out in the manner of plagioclase lamellæ. From a study of the lamellæ in an equatorial section of quartz supposed to be one of those investigated by Brewster, Professor Judd concludes that quartz is dimorphous. What he calls "stable quartz" shows no tendency to assume a lamellar structure, whereas "unstable quartz" constantly exhibits such a tendency. The latter variety is usually amethystine. The lamellæ consist of alternating bands of

[7]Min. Mag., X, p. 123.

right and left handed quartz. When they are bent or disturbed they furnish biaxial interference figures. Many crystals are composed of both stable and unstable quartz, the relative positions of which show some relation to the symmetry of the crystal. Such crystals, or crystals composed entirely of unstable quartz, have the lamellæ induced by great mechanical stresses. The fact that the structure is only faintly induced and that very near the fracture in artificially crushed crystals, is explained by the short time during which the stress is applied, permanent structure being produced only after a long application of thé stress.

PETROGRAPY.[1]

Contact Effects around Saxon Granites.—The effects of the granite and syenite of Lausitz, of the granitite of Markersbach and of the tourmaline granite of Gottleube upon the rocks through which they cut in the Elbthalgebirge in Saxony, are concisely described by Beck.[2] The members of the phyllite formation and the beds of Cambrian, Silurian and Devonian age, whatever may have been their nature, have all undergone contact metamorphisen near ther junction with the eruptives. During the process of alteration there seems to have been little addition of material to the metamorphosed rocks, as all the contact products when originating from the same member of the bedded series are the same, irrespective of the nature of the metamorphising eruptive. The great variety in the contact products of the region is due solely to differences in the character of the originals of the altered rocks. The phyllites have been changed to 'Fruchtshiefer' and into andalusite mica schists, chlorite gneisses into biotite gneiss, and feldspathic quartzites into hornfels. The Silurian slates near the contacts have become hornstones and knotty schists, carbonaceous quartz schists have changed into graphitic quartzites, graywackes and marbles have been made crystalline, and the latter rock has in many cases been changed into a calc-silicate aggregate, which has been impregnated with ore masses, presumably originally in the granitite with which the limestones were in contact. Diabases and diabase tuffs in proximity to the intrusive rocks have been amphibolized. The Devonian rocks have suffered the same alterations as the corresponding Silurian ones, and in addition there has been formed a gneiss-like rock whose predecessor among the clastics is unknown. A large number of contact minerals are discussed at length by the author, chief among them being quartz, plagioclase, cardierite and graphite. The article is full of instructive suggestions though nothing of striking novelty is met with in it.

The Schists of the Malvern Hills.—Callaway[3] has published a final summary of the conclusions based on seven years work in the Malvern Hills. He reiterates his belief that the schists of the region

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2]Min. u. Petrog. Mitth. XIII, p. 290.
[3]Quart. Jour. Geol. Soc., XLIX, p. 398.

are squeezed eruptives, and discusses the physical, mineralogical and chemical changes that have effected the alteration of the granites and diorites into gneisses and schists of various kinds. His conclusion that a sericite schist may be derived from diorite and that biotite is often an alteration product of chlorite are both of great interest. In the change of a massive into a schistise rock, the author states that the former "passes through the intermediate state of a laminated grit, which thus simulates a true sediment, the subsequent stages of alteration and cementation resembling the process of metamorphism in some bedded rocks." In the production of the foliation there is decomposition of the original components of the massive rock and a reconstruction of new minerals largely from these decomposition products. In the Malvern Hill rocks orthoclase has been replaced by quartz and muscovite, plagioclase by quartz and muscovite, chlorite by biotite and white mica, and biotite by a white mica. A number of analyses appear in the paper to illustrate the chemical changes that have accompanied the physical ones through which the respective rocks have passed.

A Soda-Rhyolite from the Berkeley Hills, Cal.—In the Contra Costa Hills near Berkeley, California, are occurrences of a volcanic flow that has been investigated by Palache,[4] who recognizes three facies of the rock. In the first, the porphyritic phase, phenocrysts of quartz and feldspar are abundantly disseminated through a micro-grauular aggregate of the same minerals. The second phase is characterized by the possession of numerous small spherulites in a glassy matrix, in which are a few small grains of magnetite and some feathery aggregates of chalcedony. The third phase is a glass containing tiny microlites of feldspar and grains of magnetite. Analyses of the different types indicate that the material of each type has the composition of a soda-rhyolite. The spherulitic variety which is intermediate between the other two, in its acidity is composed as follows:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	Total	Density
75.46	13.18	.91	.95	.10	1.09	6.88	.93	= 99.50	2.42

Diabases from Rio Janeiro, Brazil.—Sections from a series of twelve diabase dykes from Rio Janeiro, Brazil, have been investigated by Hovey,[5] with some interesting results. The chemical composition

[4]Bull. Dept. Geol. Univ. Cal., Vol. 1, p. 61.

[5]Min. u. Petrog, Mitth. XIII, p. 211.

of all the dykes is practically the same. Their mineral composition and structure, however, vary. In the largest dykes the number of constituents discovered is much greater than in the smaller ones. They embrace the usual diabase components with the addition of a light colored sahlitic pyroxene differing from the sahlite of Sala in the value of its optical angle. In the Brazil mineral $E_a = 32° 39'$, while in the Sala mineral it is 112° 30'. It is the oldest constituent of the rock after magnetite, and, consequently it is that which approaches most nearly to being idiomorphic. The structure of the large dykes is gabbroitic and ophitic, whereas that of the small ones is porphyritic and hyalopilitic, with the pyroxene figuring as the phenocrysts. Quartz is not uncommon in the coarser rocks and granophyric intergrowths of quartz and feldspar are frequently met with.

The New Island off Pantelleria—A Correction.—In these notes for December[6] last, the statement was made concerning the material of a recent eruption near Pantelleria, that it consisted of loose blocks and of lava. Mr. G. W. Butler of Chertsey, England, corrects this statement in a recent letter to the writer and declares that the new island formed during the ernption was composed entirely of loose scoriaceous bombs, which disappeared a short time after the eruption ceased.[7]

Petrographical Provinces.—Iddings[8] gives a brief and, consequently, a tantalizing account of the old volcano of Crandall Basin in the Absaranka Range of Mountains in the Yellowstone National Park, that has been eroded in a manner to give a good section of the cone with the dykes and flows radiating from it. The different rock types mentioned in the paper are simply alluded to, a full account of them being promised later. The author's conclusion from his study is to the effect that we have here proof that the texture of rocks and their mineral composition is more directly dependent upon the rapidity with which the rocks cooled, than upon the pressure to which they were subjected during their solidification. The differentiation of rock magmas is also well shown in the case of the volcano studied by the production of many individual rock types.

Upon comparing thirty-nine of the best analyses of rocks occurring in the eruptive areas around the Bay of Naples, Lang[9] concludes that

[6]American Naturalist, Dec., 1893, p. 1088.
[7]Cf. also G. W. Butler; *Nature*, April 21, 1892.
[8]Jour. Geol., Vol. 1, p. 606.
[9]Zeits. d. deutsch. geol. Ges. XLV, p. 177.

there are here three independent volcanic centers, represented respectively by Ischia, Vesuvius and Mt. Nuovo. That they are on different volcanic fissures is indicated by the differences in the character of the lavas extruded from them, especially in their sodium and calcium contents. At each center each magma became differentiated, and this differentiation explains the variety of the rock types discovered in each.

'A study in the consanguinity of eruptive rocks' is the title of an article by Derby[10] in which is shown the fact that the occurrence of the eleolite syenites, phonolites, monchiquites and other related rocks in Brazil, point to the correctness of the notions of differentiation and consanguinity as explanatory of the existence of different phases of eruptive rocks within the same volcanic sphere. The author also shows that, while not having formulated the theory, its principle has been the guide in his work on the Brazilian rocks.

Miscellaneous.—Upon examining spherulites of lithium phosphate between crossed nicols, McMahon[11] finds that some of the groupings present apparently miaxial crosses which remain fixed in position during a complete revolution, while in others the cross breaks up into two hyperbolic branches resembling those of biaxial optical figures. The phenomenon, the author regards as due to molecular strains that affected the spherulites at the time of their crystallization.

[10]Jour. Geol., Vol. 1, p. 579.

[11]Mineralogical Magazine, X, p. 229.

BOTANY.[1]

Thaxter's Studies of the Laboulbeniaceæ.—Mr. Thaxter has recently issued the fifth of his preliminary papers upon the *Laboulbeniaceæ* preparatory to the monograph of that group upon which he is engaged. In this paper he describes four new genera and fourteen new species, and gives a synopsis of the described species of the group. As it is indicated that the paper in question is to be the last of his preliminary papers, a few words as to his work upon the group and the effect which it seems likely to have may be timely.

Although the first representatives of the family were noticed as early as 1853, and received their first systematic treatment in 1869, it is only within a short time that the group has been thoroughly studied and any great number of forms discovered. In fact the great majority of the forms have been found in this country by Mr. Thaxter. In the first of his preliminary papers, in 1890, Mr. Thaxter states the total number of described species at fifteen. In the present paper he enumerates in the course of his synopsis twenty-three genera and one hundred and twenty-two species. The difference is mostly due to his researches.

The *Laboulbeniaceæ* are parasites on the outer surfaces of insects, principally of insects which live in or about the water. They grow either singly or in a thick fur, and are very minute, the largest not exceeding 1 mm., and most species being about 0.5 mm. in length. They have no mycelium and consist solely of a short stalk and a reproductive apparatus.

Reproduction in these fungi is of one sort only. Karsten was the first to describe it and he compared it to the sexual reproduction in the *Florideæ*. Peyritsch afterward made more exact and extensive observations and came to the conclusion that the supposed abscission of spermatia did not take place and that the sexual nature of the process was doubtful. Since these observations little or nothing has been published on the subject and for that reason the following statement made in the present article is of great interest:

"The writer's observations, based upon an examination of several thousand specimens illustrating more than one hundred species and

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

more than twenty genera, appear to warrant the following conclusions."

"The *Laboulbeniaceæ*, while showing no signs of any non-sexual mode of reproduction are characterized by a well marked sexual type closely resembling that of the simpler *Florideæ*."

He goes on to give a summary of the process, which cannot well be abbreviated, and which is too long to be repeated in this place. Suffice it to say that he has found that "the trichogyne varies from a simple vescicular receptive prominence, or short filament, to a copiously branched and highly developed organ," that, however highly it may be developed, it always disappears immediately after fertilization; that the antherozoids are non-motile spherical or rod like masses of naked protoplasm, which originate in two genera exogenously from special branches and in other genera are produced endogenously in antheridia; that the antheridia are either single specialized cells or highly developed multicellular bodies, from which in either case the antherozoids are discharged through a terminal pore. It appears also that while the sexes are commonly present in the same individual, in some species they are completely separated on specialized individuals.

Although the observations, on which the foregoing conclusions are based, are not given, we may take it to be settled that the doubts as to the nature of the reproduction in these fungi raised by the observations of Peyritsch are set at rest. If so, several interesting questions arise.

There seems to be no doubt, as Mr. Thaxter remarked in a prior paper, that these fungi are real *Ascomycetes*. Indeed their title to a place in that group seems much better than that of some others which are included with little hesitation. If they are *Ascomycetes*, the ghost of the much vexed question of sexual reproduction in that group, which it was supposed had been effectually laid by Brefeld, must soon begin anew its visitations. And in any case, since the relationship of the *Laboulbeniaceæ* to the *Ascomycetes* as a whole must be close, even though they have no apparent relationship to any particular group of them, the whole scheme of the relationship of the *Ascomycetes* framed by Brefeld and his followers is placed on very shaky ground by the conclusions which Mr. Thaxter has announced.

After it had been shown that there was no sexual process in the *Ascomycetes*, the question remained, to what fruiting stage of the simpler fungi does the ascus stage of the *Ascomycetes* correspond. Brefeld has answered this by comparing it with the sporangium fructification of the *Mucoraceæ*. The ordinary *Ascomycetes*, called *Carpoasci*, he derives

through *Thelobolus* from the carposporangic *Zygomycetes*, as *Mortierella*.

But the fact that in the *Laboulbeniaceæ* an ascus fructification is produced as the result of a sexual process throws grave doubt upon this theory, if it does not wholly overthrow it. It seems clear that the process of reproduction in these fungi, as outlined by Mr. Thaxter, indicates that the comparison of the ascus to the sporangium of the *Mucoraceæ* is wholly erroneous and that DeBary was right in considering it homologous to the sexual fructification of the *Phycomycetes*, whether or not he was wrong in believing it to be in many cases the result of a sexual process. It is perhaps not without significance that works like Von Tavel's Morphologie do not notice the *Laboulbeniaceæ* at all.

Another and still more interesting question will be presented when some one in the light of the development of the *Laboulbeniaceæ* ventures to reopen the question of the formation of the spore-fruit in the *Ascomycetes* and to question the conclusions of Brefeld. That the evidence must be reexamined seems to be clear if the conclusions announced by Mr. Thaxter are sustained by his observations. We have come to regard all accounts of sexual processes in fungi as doubtful since the writings of Brefeld have produced a school of sceptics on such points. If in a group which must be admitted to be immediately related to the *Ascomycetes*, if not a veritable member of them, which it evidently is, antheridia, antherozoids, and trichogynes—terms which the works on the morphology of the fungi have agreed to discard for the higher fungi—actually occur, we cannot rest content with any explanation of the formation of the sporocarp in the *Ascomycetes* which leaves any phenomenon apparently connected with those found in the *Laboulbeniaceæ* unaccounted for.

Mr. Thaxter's brief sketch suggests many coincidences which serve to convince one that the ghost of the DeBaryan theory as to the *Ascomycetes* will not down and that we may expect it to visit our slumbers nightly until we find some better means of reconciling the *Laboulbeniaceæ* with current theories as to the *Ascomycetes* than at present seems possible.

Mr. Thaxter's forthcoming monograph will be awaited eagerly by all who are in any degree interested in the morphology and biology of the fungi. It goes without saying that his previous work is a guaranty that our expectations will be amply realized.

ROSCOE POUND.

ZOOLOGY.

The Antennal Sense Organs of Insects.[1]—During his studies carried on in Leuckart's laboratory on the peculiar sense organ in the the base of the antenna of certain Diptera (*Mochlonyx culiciformis, Corethra plumicornis*), Mr. C. M. Child found that the organ occurs generally in Diptera, and, if not generally, at least very often in the other orders of Insects.

In the wasp (*Vespa vulgaris*) the organ occurs in the second joint of antenna. Near the end of the first joint the main nerve of the antenna gives off branches on all sides. These run toward the periphery of the second joint, connecting with ganglion cells, which in turn connect with small rod-like bodies that end in the articular membrane between the second and third joints. These rods are gathered into groups each of which ends in a pore in the membrane. On the outside of the antenna no sense hairs are found corresponding to these pores, which seem to be closed on the outside. Between the rods nuclear elements were found, but whether they were of connective tissue or of nerve elements was not determined. An organ similarly placed and of similar structure is to be found in the genera: *Melolontha* (*Coleoptera*), *Epinephele* (*Lepidoptera*), *Bombus* (Hymenoptera), *Pachyrhina, Tabanus, Syrphus, Helophilus, Musca, Sarcophaga* (Diptera) *Sialis, Panorpa*, and *Phryganea* (Neuroptera), *Libellula* (Pseudoneuroptera.)

Of the Hemiptera only the Homoptera were investigated. Here the rods and ganglion cells are fewer in number. *Periplaneta, Locusta* and *Stenobothrus* among Orthopteran genera have a structure in the second antennal joint with ganglion cells and long fibrous rods. Thysanura were not studied.

In certain Diptera (Culicidæ and Chironomidæ) the organ is somewhat different. At the base of the antenna of both sexes there is a nearly spherical joint. This is larger in the male than in the female. In the latter the nervous structure within this joint is much more readily comparable to the organ described for the wasp than that in the male. But even in the male the structure may be reduced to the general type. In the female the rods instead of ending at the periphery of the second joint are directed toward the middle of the long feeler. The large antennal nerve runs chiefly to the ganglion cells, giving off two small branches that run on into the other joints of the antenna. There is no

[1] Zool. Anz. XVII, p. 35, 1894.

sharp line to be drawn between the ganglion cells of the organ and the brain. The rods are delicate and covered with small nuclei very well supplied with chromatin.

To what has already been made known by Weismann and Hurst on the general development of the antenna in these insects, Mr. Child adds that the entire sense organ is formed from a fold at the base of the invaginated hypodermal cavity, and that the differentiation of the rods and ganglion cells takes place very early.

The organ he considers to be auditory in function, agreeing with Johnston, Mayer and Hurst.[3] Supporting this view is the fact that the rods are so placed as to be affected by any slight motion imparted to the distal part of the antenna, either by sound waves or otherwise. It has been repeatedly shown by others that certain insects seem to hear by means of their antennæ. To offset the fact that the so-called tympanum of certain Orthoptera is considered to be auditory he recalls the experiments by Graber, who found that insects in which the tympanum had been destroyed still reacted to sound waves which affected the antennæ or in some cases the legs. The organ is of further interest in that there is shown in it no marked difference between hearing and touch.—F. C. Kenyon.

The Luminous Organs of Histioteuthis rueppellii Verany.—Dr. Joubin has recently been making a study of the luminous organs of a rare cephalopod, *Histioteuthis rueppellii*, found near Nice. The animal belongs to the abyssal fauna and the specimen in question is over a meter in length. The author describes the outward appearance of its phosphorescent organ, and its internal organization, comprising a reflector, which the author calls a mirror and an apparatus for producing light. Mr. Jourbin offers the following theory of the use of the luminous organ to the animal.

" Ordinarly the light-producing apparatus does not function. It is like a machine at rest. But if a living creature suitable for food wanders into the vicinity of the cephalopod, this prey being of a higher temperature than the water in which it floats emits caloric radiations. These heat rays impinge on the reflecting mirror and are then concen-

[3] Johnston.—Auditory Apparatus of the Culex Mosquito. Journ. Micr. Sci. III, old series.

Mayer.—Reseaiches in acoustics. Am. Journ. Sc. Series III, vol. 8.

Hurst.—The Pupal Stage of *Culex*, Inaug.-Diss. Leipzig, 1890.—On the Life History and Development of a gnat. Trans. Manchester, Micro. Soc., 1890. The Post-embryonic Development of Culex. Proc. Liverpool Biol. Soc. IV.

trated in the light-producing apparatus, causing there a sensation, and the organ functions by reflex action. The surrounding medium is then illuminated by rays perceptible by the eye of the animal. In a word, these organs are the organs of a caloric sense. Heat sensations are the only kind that can be felt in those abysses when the darkness is relieved by occasional gleams of phosphorescent light. I add, finally, that I have found in another cephalopod an extremely curious organ constructed in such a manner that it does not perceive light rays, but can only receive heat rays, which confirms the hypothesis just advanced," (Bull. Soc. Sci. et Med. de l'Ouest France, t. II, no. 1893.)

Verrill's Organ.—In the funnel of certain Cephalopods, several authors have noticed a peculiar cushion-like organ, situated a little behind the valve, and this has, for very insufficient reasons, been called Verrill's Organ by Hoyle and others. Its function and homology have been the subject of some discussion. Ferussac and D'Orbigny confused it with a transverse muscle; H. Müller, in 1852, thought it was a stinging organ; Verrill, in 1882, considered it "the true homologue of the foot of gasteropods;" Laurie, in 1888, from rather insufficient material, showed its glandular nature, and believed that it secreted mucus, but his observations were criticised by Brock; Hoyle, in 1889, believed that it served to close the funnel. That it is really a mucous gland is now proved by the careful observations of G. Jatta (Boll. Soc. Nat. in Napoli, vol. VII, p. 45, 1893), who has observed it in 32 species belonging to 21 genera, thus bringing the number of genera in which it has been found from 10 to 27. He describes and figures six main modifications of its arrangement, and gives excellent drawings to show its microscopic structure in different stages of its development. He concludes that this funnel organ is a mucous gland homologous with the pedal glands of other mollusca. If this be so, the organ must be somewhat archaic, and one would expect to find it in *Nautilus*, where, to the best of our knowledge it has never been described. (Nat. Sci., Feb., 1894.)

Preliminary Descriptions of Some New South American Characinidæ.—1. *Tetragonopterus heterorhabdus.* This species is related to *T. schmardæ* Steindachner. It is readily distinguished from *T. schmardæ* by the conspicuous dark lateral band which has on the anterior end an oval expansion resembling the humeral spot present in in many species of *Tetragonopterus.*

D. 10; A. 20–23; head $3\frac{1}{2}$; depth $3\frac{1}{2}$, eye in the head $2\frac{1}{2}$ and once in the inter-orbital; scales 32–34, the lateral line incomplete, only 6 scales perforated.

Maxillary toothless, extending nearly to the centre of the pupil of the eye. The dark-brown lateral band, deepest colored anteriorly, edged above with a conspicuous silvery band. No caudal spot. Dorsal about midway between the tip of the snout and base of the caudal, and over the space between the anal and ventral. Anal with first six rays elongate. Many specimens from Brazil. Length 10–29 mm.

2. *Tetragonopterus paucidens.* Related to *T. diaphanus* Cope from which it differs in having 1 to 3 maxillary teeth; in proportions and in lateral markings.

Head $3\frac{1}{2}$; depth $2\frac{3}{4}$, in the length. Snout $3\frac{1}{2}$, diameter of the eye 3 in the head. The maxillary extends to the anterior border of the pupil. A silvery lateral band and a diffuse caudal spot present. No humeral spot.

D. 11; A. 19; scales 5–31–3; lateral line complete. Length 45 mm.

One specimen from Itaituba, 45 mm. long.

3. *Tetragonopterus santaremensis.* This species has much the appearance of *T. bellottii* Steindachner. The scales of the lateral line are perforated to the base of the caudal while in *T. bellottii* only 5 to 7 scales are perforated. The caudal spot is somewhat more rhomboidal and extends to the end of some of the rays, otherwise the lateral band and humeral spot are about as in *T. bellottii.*

Head $3\frac{1}{2}$; depth $3\frac{1}{4}$ in the body. D. 10; A. 20–22; scales 5–30–3. Anterior dorsal and anal rays elongate. Snout short, 4 in the head. Maxillary toothless, extends to the eye. Diameter of the eye somewhat more than the width of the inter-orbital and $2\frac{1}{2}$ in the head.

Ten specimens from Santarem, 8–24 mm. long.

4. *Tetragonopterus astictus.* Related to *T. humilis* Günther. It differs from that species in having no caudal or humeral spot, no red margins on the anal and ventral fins and fewer rows of scales.

Head $3\frac{1}{2}$, depth $3\frac{1}{2}$, in the length. Eye $2\frac{1}{2}$ in the head and once in the inter-orbital space. A silvery lateral band present, most distinct posteriorly.

Lateral line complete, scales 5–35–$3\frac{1}{2}$. D. 10; A. 30. Maxillary toothless, extending a little past the anterior margin of the orbit.

One specimen 53 mm. long from Brazil.

5. *Aphyocarax maxillaris.* Maxillary with minute teeth along its entire margin. Intermaxillary with about ten teeth, the inner four three-pointed. Mandible with a few conical teeth in front.

Depth 3–$3\frac{1}{3}$; head $3\frac{1}{2}$. D. 11; A. 22–23 scales; 30, tubes 6. Snout very short, the maxillary extending beyond the anterior margin of the eye.

A small circular humeral spot present, sometimes reduced to two or three color cells. A large black spot on the upper half of the first dorsal rays, the tips of these rays white. A small black spot near the tip of the first fur and rays.

A. agassizi Steind. differs from *A. maxillaris* mainly in its larger number of anal rays. Brazil, 10 specimens, 10–11 mm. long.

6. *Aphyocarax heteresthes.* Maxillary teeth six, conical. Intermaxillary with eight conical teeth and two with lateral cusps on each side. This species is related to *A. agassizii* Steindachner and *A. eques* Steindachner. From the former it differs in having only the upper part of the maxillary dentiferous and apparently in having the anal rays graduated. From the latter it differs chiefly in having no humeral spot.

Depth 3; head $3\frac{1}{3}$. D. 11; A. 27–30; scales about 31. Snout very short, maxillary long, extending considerably beyond the anterior margin of the eye. Eye twice the length of the snout, $\frac{2}{7}$ the length of the head. Origin of the dorsal midway betweeen the tip of the snout and the base of the caudal. Upper half of the first five developed rays of the dorsal black.

Brazil, 6 specimens, 14–17 mm. long.

7. *Mylesinus macropterus.* Body deep, $1\frac{5}{7}$ in the length. Head $3\frac{1}{2}$. Abdominal serrations 11 behind the ventrals, the posterior four in pairs, 22 to 25 smaller ones before the ventrals.

D. I, 16; A. 36; V. 7. Scales small, about 83 in the lateral line which is deeply curved below the origin of the dorsal. Height of dorsal fin $2\frac{2}{3}$ times its length, the second and third rays greatly elongate, the fourth ray about half as long. Anal without lobes.

Snout little more than half as long as the diameter of the eye, the inter-orbital space a little more than the diameter of the eye. Lower jaw greatly projecting. Teeth in the mandibles in one series, notched and wide apart.

Brazil, 1 specimen 9 cm. long.

ALBERT B. ULREY, Bloomington, Ind.

On the Species of Himantodes D. & B.—This genus of snakes is represented by numerous individuals in tropical America, and sufficient material is now at hand to render it possible to determine the number of species to which they belong. An examination shows that

the typical species *H. cenchoa* L., does not occur in Central America and Mexico, the individuals which have been hitherto referred to it, representing another species, which I call *H. semifasciatus*. Of the seven species, five belong to this region, and two to continental South America.

I. A small additional superior preocular plate.

Scales in 17 rows; superior labials 4 and 5 in orbit; one scale in first temporal row; vertebral row enlarged; dorsal spots extending to gastrosteges throughout; *H. cenchoa*[3] L.

II. One large preocular plate only.

α. Scales in 15 rows.

One scale in first temporal row; superior labials 4, 5, and 6 bounding orbit; vertebral row enlarged; dorsal spots terminating in an angle near gastrosteges; no lateral spots; *H. lentiferus* Cope.

αα. Scales in 17 rows.

β. One scale in first temporal row.

[Two labials in orbit; vertebral scales enlarged; on posterior two-thirds the length the dorsal spots are small and lateral spots are present; exceptionally, *H. semifasciatus* Cope.]

Two labials in orbit; vertebral scales similar to the others, spots as in *H. semifasciatus*; *H. gemmistratus* Cope.

ββ. Two scales in first temporal row.

υ. Dorsal spots continued to gastrosteges throughout.

Vertebral row enlarged; superior labials 4 and 5 in orbit; *H. leucomelas* Cope.

Vertebral row like other scales; superior labials 4, 5, and 6 in orbit; *H. tenuissimus* Cope.

υυ. Dorsal spots reduced posteriorly; lateral spots.

Vertebral row enlarged; *H. semifasciatus* Cope.

[Vertebral row like others; exceptionally, *H. gemmistratus* Cope.]

III. A small inferior preocular plate.

β. Two scales in first temporal row.

Scales in 17 rows; vertebrals large, wider than long; labials 4 and 5 in orbit; dorsal spots continued to gastrosteges throughout; *H. anisolepis* Cope.

Himantodes lentiferus sp. nov. Besides the characters already mentioned, this species exhibits the following: Labials eight above, ten below. Seventh superior labial as high as long; temporals 1–2–3. Postgenials in contact anteriorly, separated by two scales posteriorly.

[3] Specimens from Brazil and E. Ecuador from Prof. Orton.

Superior postocular three times as large as inferior. Vertebral scuta wider than long. While the dorsal spots are acute angled below generally, they are not so on the tail and anterior region; on the latter many of them are separated by a much smaller vertebral spot. Top of head brown, brown spotted; lips and throat unspotted; other inferior regions black speckled. Total length 622 mm.; tail 189 mm. Pebas, Ecuador, J. Hauxwell; E. Equador, J. Orton.

The characters of this species are well marked, as compared with those of the *H. cenchoa.* Of the latter I have four from Peru (Orton) and one from Ecuador (Hauxwell.)

Himantodes semifasciatus sp. nov. The width of the vertebral series of scales varies in the numerous specimens I have assigned to the *H. semifasciatus;* in some the width is nearly equal to the length, while in others it is considerably less. The apices of the vertebral scales are, however, always truncate, and never acuminate like the other scales, as is seen in the *H. gemmistratus.* There are usually two scales in the first temporal row in this species, while there is invariably only one in the *H. gemmistratus,* but in three of the nine Costa Rican specimens there is but one scale. The largest specimens belong to the *H. semifasciatus.* One of these (No. 101) measures; total length 1125 mm.; tail 380 mm.

Ten specimens from Costa Rica; Paso Azul, Santa Clara, Carrillo, Alajuela, Monte Aguacate, and San Josė; from the Museo Nacional, through Geo. K. Cherrie. Two specimens in Mus. Academy, Philada. from Nicaragua.

Himantodes anisolepis sp. nov. Besides the characters already mentioned, the following may be noted. The small inferior preocular is cut from the fourth superior labial; the labials number eight above and ten below. The lower post-ocular is one-third the size of the superior. Temporals 2–2–3. The postgenials are entirely separated by scales. Thirty-nine brown spots from the head to the vent, which extend nearly to the gastrosteges, with truncate or rounded inferior border, on a very pale ground. Belly unspotted. Total length 420 mm. of tail, 127 mm. Monte Aguacate, Costa Rica, G. Witting.

This slender species resembles in coloration the *H. tenuissimus* and *H. leucomelas.* It differs sufficiently in scale characters from both.—E. D. Cope.

Zoological News.—M. de Guerne recently reported to the *Société Acclimatation de France* the capture in the open sea of a female eel bearing mature eggs. (Rev. Sci. March, 1894.)

Prof. Carl Eigenmann is in receipt of a Ling (*Lota lota maculosa*) from the Columbia River which does not show any specific differences from those of Lake Michigan. This fish is found in all three of the large water basins of the Atlantic slope—the Saskatchewan, St. Lawrence and Mississippi, and its distribution is now extended to the Pacific Slope. (Science Vol. XXIII, 1894.)

Distomum leptodon, a new Trematode from the intestine of *Aplodinotus grunniens* (River Drum) has lately been described by W. G. MacCallum in a paper before the Natural Science Association of Toronto University.

ENTOMOLOGY.[1]

The Pear Leaf Blister.—Mr. M. V. Slingerland has recently rendered an important service to economic entomology by showing that the injuries of *Phytoptus pyri*, the mite which causes the pear leaf blister can be controlled by spraying the trees in winter with kerosene emulsion. In a recent bulletin[2] he presents the most satisfactory account of this pest that has yet been published, recording the experiments which have led to the discovery of the remedy. The disease is said to appear on the leaves early in spring "in the form of red blister-like spots an eigth of an inch or more in diameter. During this red stage of the disease, the spots are more conspicuous on the upper surface of the leaves. About June 1, the spots gradually change to a green color hardly distinguishable from the unaffected portions of the leaf; this change takes place on the lower side of the leaf first, and the spots may thus be red above and green below. In this green stage, which seems to have been overlooked, the badly diseased leaves present a slightly thicker corky appearance; otherwise the disease is not readily apparent especially where not severe. This green stage lasts about a week or ten days; and about June 15, the spots may be found changing to a dark brown color beginning on the lower side of the leaf. The tissue of the diseased parts or spots then presents a dead, dry, brown or black, corky appearance. The spots are also more conspicuous on the lower side and remain unchanged until the leaves fall in the autumn. They occur either singly scattered over the surface of the leaves or often coalesce forming large blotches which sometimes involve a large portion of the leaf."

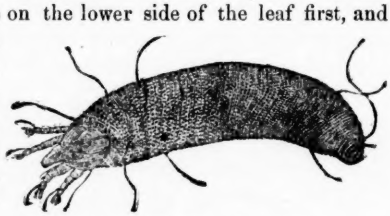


Fig. 1.—*Phytoptus pyri*. Magnified.

In describing the life history of the Phytoptus mite Mr. Slingerland says: "The exceedingly minute oval grayish eggs are laid by the females in the spring within the galls that they have formed, and here

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Cornell University Agr. Exp. Station Bull. 61, pp. 317–328

Fig. 2.—Section of leaf showing gall in red stage, *n*, *n*, normal leaf; *o*, opening of gall; *e*, eggs. (After Sorauer).

the young are hatched. How long they remain within the gall of their parent has not been ascertained. But sooner or later they escape through the opening in it, and seeking a healthy part of a leaf or more often crawling to the tenderer leaves of the new growth, they work their way into the tissue and new galls are thus started. In this manner the galls on a tree are often rapidly multiplied during the summer. The mites live within the galls, feeding upon the plant cells, until the drying of the leaves in the autumn. They then leave the galls through the openings and migrate to the winter buds at or near the ends of the twigs. Here they work their way beneath the two or three outer scales of the buds where they remain during the winter. Fifteen or twenty may often be found under a single bud scale. In this position they are ready for business in the spring as soon as growth begins; and they doubtless do get to work early for their red galls are already conspicuous before the leaves get unrolled.

"The mites instinctively migrate from the leaves as soon as the latter become dry. Whenever branches were brought into the insectary, as soon as the leaves began to dry, the mites left them and gathered in great numbers in the buds. It is impossible to accurately estimate the number of mites that may live in the galls on a single leaf. Sections of galls made while in their red stage would seldom cut through more than two or three mites; but sections of the brown galls often showed four or five times as many. Thus on a badly infested leaf there is without doubt at least a thousand of the mites."

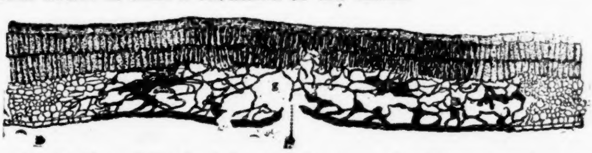


Fig. 3.—Section of the leaf showing structure of gall in autumn; *g*, gall; *n*, normal leaf; *o*, opening of gall.

The upper figure on the accompanying plate shows a cluster of infected leaves representing the brown stage of the disease as seen from below on three leaves and from above on one leaf; and the lower one shows part of an infested leaf, seen from below, with several of the galls considerably enlarged.

Termite Societies.—Professor B. Grassi and Dr. A. Sandias have investigated the nature and origin of the Termite society in *Calotermes flavicollis* and *Termes lucifugus.* A Calotermes colony may include (*a*) indifferent larvæ, capable of becoming soldiers or sexual members; (*b*) larvæ and pupæ of sexual members with rudiments of wings; (*c*) soldier larvæ and soldiers which may arise from *a* and *b*; (*d*) winged sexual insects: (*e*) a true royal pair with vestiges of wings; (*f*) larvæ of 'reserve' sexual members and the reserve kings and queens which arise from these. These last larvæ may be developed from *a* or from various stages of *b*.

In the Termes nest there is a special caste of workers and no distinctive royal pair. The society includes (*a*) very young indifferent larvæ; (*b*) larger larvæ and the workers and soldiers to which they give rise; (*c*) winged sexual animals; (*d*) various stages of reserve and complementary sexual animals.

The one type, that illustrated by Calotermes, is founded by a king and queen, who may be replaced by a pair of reserve royal individuals, *i. e.* by a 'neotænic' couple. The second less primitive type, illustrated by Termes, contains several 'neotænic' couples, while kings are only temporary; in this case the nest arises in a secession from an older colony.

One of the most interestsng results concerns the influence of nutrition in producing polymorphism. Thus the reserve sexual members are fed not only in the larval state but afterwards from salivary secretion only, a nutritive diet which probably hastens the rapid development of the reproductive system.—*Journal Royal Microscopical Society.*

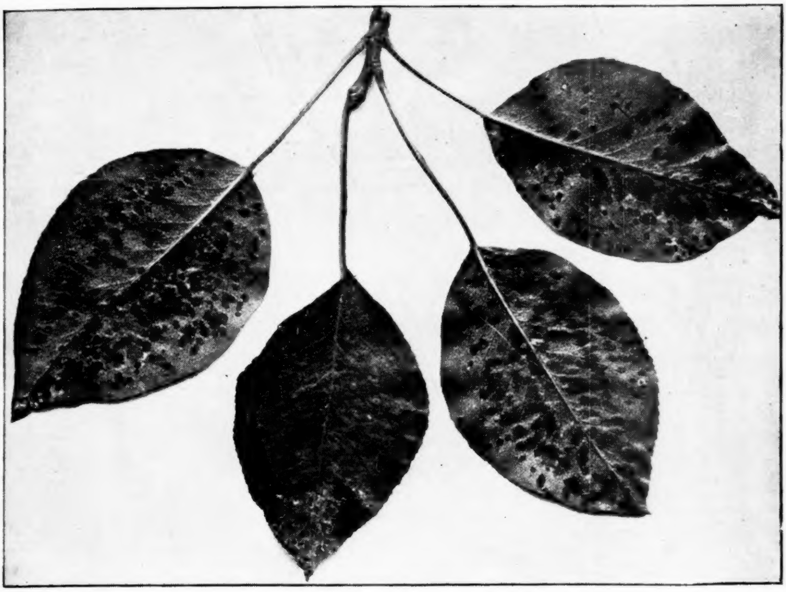
Habits of the Leaping-Ant of Southern Georgia.—In the pine forests upon the sandy loam of Thomas County, near Thomasville, Georgia, I discovered a nest of *Atta brunnea* (*Odontomachus brunneus* Roger.) No hillocks were formed, the openings to the galleries in the earth being at the surface level. The aperture was large enough to have allowed queens as large as those of *Oecodoma* to have passed, the workers (the only sex observed) of *brunnea* being much smaller. The workers jump several inches when disturbed, the leap being backwards and being caused by snapping the mandibles together.

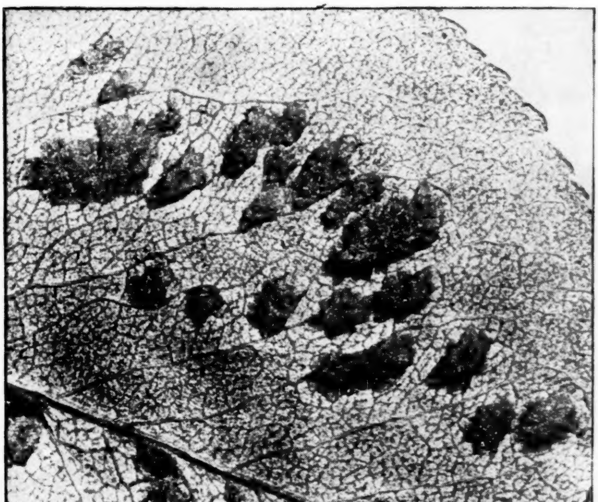
The cocoon contains the pupa of the worker in September.

ATTA BRUNNEA (Roger). Georgia.

A. (*O.*) *hæmatodes* (L.) of the West Indies may prove to be a variety of this.

PLATE XVI.





Work of the Pear Leaf Blister Mite.

☿. Length 9 mm. Of a uniform brown color. Legs and sometimes the tip of the abdomen and the head and thorax, especially beneath, are paler. Mandibles finely serrate within; the tip tridentate, middle tooth smallest. Palpi invisible, obsolete.

Tibæ all one-spurred. Scale of the petiole produced into a spine. The thorax above is densely striate, the head above with finer striations.

ATTA CLARA Texas.

☿. Uniformly honey-yellow. Scale smaller than in *brunnea*, not forming a spine.

♂. Length. 6 mm. Head ordinary, as wide as long. Eyes oval, slightly sinuate both before and behind, black. Ocelli large, white. Antennæ long as body, not elbowed; brown, except first joint. Mandibles distant, minute, their tips touching. Palpi minute. Wings clear, veins yellow, recurrent vein received in base of second submarginal cell.. Entire body and legs yellow. Abdomen hairy, second constriction deep, claspers large, scale rounded.

WM. HAMPTON PATTON, Hartford, Conn.

Note on the Winter-Ant.—Since writing the article upon this ant (AMER. NAT., Oct., '92) I have found the sexes paired in flight, at Hartford, Conn., on the third of August. This indicates the existence of a second or summer brood of the species. The male of *Prenolepis imparis* (Say) Patton, measures only about one-eigth of an inch, the female is twice as long and much more bulky. The sexes also differ in color, the males being black, the workers dark brown, and the females dark honey-yellow.

WM. HAMPTON PATTON.

PHYSIOLOGY.

Attenuation of Viper Poison.—In a commnnication published in Revue Scientifique Feb., 1894, M. M. C. Phisalix and C. Bertrand published the results of experiments made with the venom of vipers. Fresh venom from *Vipera aspis* extracted from the glands rapidly loses its virulence when subjected to a temperature of 75°–80°, and an aqueous solution so treated exhibits energetic innoculating properties against the venom itself.

They have also demonstrated that the blood of animals innoculated with this *echidno-venin* becomes antitoxic, the injection of this defibrinated blood or of the serum into the peritoneal cavity of healthy guinea-pigs, neutralized the effects of the venom.

They add that the blood of guinea-pigs protected by a poison habit, that is, by injections of pure venom in increasing quantities, administered at gradually decreasing intervals, is also antitoxic, but to a less degree than that of animals protected by vaccination. Animals protected by innoculation with antitoxic serum preserve their immunity quite a long time.

Their observations are such as lead them to believe that this antitoxic serum will prove to be a therapeutic agent.

Since then, M. Calmette, who had questioned the correctness of the results of their experiments, but who later retracted his assertions, has presented a note in which he annnounces "that one can protect animals against the venom of serpents by means of repeated doses of poison, at first weak, but gradually increasing in strength . . . . . and that the serum of the animals thus treated is at once protective, antitoxic and therapeutic." This is precisely what M. M. Phisalix and Bertrand demonstrated; but M. Calmette, not having cited their researches, they think they should lay claim to priority in publishing the important theoretical and practical consequences of this discovery, having been able to give in logical sequence the facts upon which the results are scientifically established. (Revue Sci., May, 1894).

The Secretion of Urea.—It is well known that urea exists already formed in the blood when it reaches the kidneys, and that so far as this substance is concerned, the kidneys function as eliminating organs. But in what part of the organism then is the blood charged with the urea? The researches of M. Kaufman, who has been at work

at this problem for several years, have furnished results from which he draws the following conclusions:

1. The formation of urea does not take place in the liver alone ; all the tissues produce a certain quantity.

2. The liver, however, is the most active secreter of urea in the young animal.

3. The production of urea seems to accompany the phenomena of nutrition which occur in the different tissues, and the phenomena of elaboration and of preparation of nutritive materials constantly poured into the blood by the liver. (Revue Sci., Mai, 1894).

ARCHEOLOGY AND ETHNOLOGY.[1]

Tobacco pipes in Shell-heaps of the St. John's.—By those familiar with the archeology of Florida, it will be remembered that the extended and careful researches of Professor Wyman among many of the shell-heaps of the St. John's river yielded no pipes, fragmentary or otherwise, intended for the smoking of tobacco, and that naturally the conclusion was arrived at by him that in all probability the makers of the shell-heaps were ignorant of its use.[2]

During the first two years of our investigations on the St. John's the negative results obtained by Professor Wyman awaited us also, though at the conclusion of our third season, in the island shell-heap constituting Mulberry Mound,[3] on the southern border of Orange County, near Lake Poinsett, we discovered at considerable depth from the surface a fragment of a tube of earthenware, which we believed, and which was pronounced by competent authority, in all probability to be a portion of a pipe used for the smoking of tobacco.

In the small burial mound situate on the northern extremity of the shell-heap we found two other fragments still more markedly indicating a similar use when entire. Nevertheless, the shell-heap fragment and those from the burial mound, assuming the contemporaneity of the two, while strong evidence as to the presence of tobacco pipes in the shell-heaps, were not final.

At the close of our fourth and last season of investigation of the river mounds (April, 1894) we again visited Mulberry Mound, making an excavation about 16 by 24 feet and 16.5 feet in depth to the water level.

At a depth of 6 feet from the surface was discovered a tobacco pipe of earthenware, complete in every part, of which we give a representation. (Plate XVII.)

Thus we have positive evidence that the men under whose feet slowly grew the great mass of powdered shell and other kitchen refuse now known as Mulberry Mound were familiar with the use of tobacco.

It is fair to explain, however, as we have previously stated in the NATURALIST, that Mulberry Mound is by no means a type of the shell-heaps of the river, since the debris of which it is composed is compara-

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

[2] "Fresh Water Shell Mounds of the St. John's River, Florida," page 59.

[3] Naturalist, Aug. 1, 1893.

tively rich in relics connecting it with a period presumably much later than most of the shell-heaps which yield little or nothing to the investigator, some even giving no evidence of the presence of sherds to the most careful and prolonged search.

The failure to find tobacco pipes in the other shell-heaps after years of investigation may at least suggest the question whether the smoking of tobacco was practiced when the older shell-heaps were made. It might be suggested, however, that, as in upwards of eighty sand mounds of the river, the majority of which were leveled to the base by us, but five tobacco pipes were met with, a proportionate infrequency of occurrence might be expected in the shell-heaps. To this we would reply that we by no means concede the contemporaneity of the sand mounds with the earlier shell-heaps; and even were a contemporary existence shown one might expect pipes, or fragments of pipes, in greater numbers in shell-heaps which represent longer periods of occupancy than in the sand mounds. The deposit of articles and certain classes of articles in the sand mounds was voluntary and dictated by custom; while into the debris of shell-heaps objects found their way through loss, if unbroken, and through rejection, if fragmentary or imperfect. Articles discovered in the shell-heaps afford a fair idea of the possessions of the men who made them. Most of us know to our cost the fragile character of a tobacco pipe of earthenware, and it is quite evident that portions of pipes accidentally broken, not to be expected in the sand mounds, since these "high places" were not used for domicile during construction, must be looked for in the shell-heaps whose makers lived upon them.

We are, therefore, of the opinion that the finding of a tobacco pipe in so exceptional and in such a presumably late shell-heap comparatively as Mulberry Mound, does not establish the use of tobacco as existing among the makers of the earlier shell heaps of Florida.

CLARENCE B. MOORE.

Norse Remains in the Neighborhood of Boston Bay.[1]— The late Professor E. N. Horsford was the first to call attention to the evidences of the truth of ancient Sagas which claim for the old Sea

[1] I received the following paper from Mr. Gerard Fowke, late of the Bureau of Ethnology, Washington, last night (June 27, 1894).

Archeology must watch with keen interest and sympathy the work undertaken by him for Miss Cornelia Horsford of excavation at the alleged sites of Norse occupation in the Charles River Valley, Massachusetts. Much discussion and prejudice has beclouded the important problem which he and Miss Horsford have

Rovers of Norway the honor of discovering America nearly five centuries before Columbus. He spent many years in this study and found dams, docks, wharves, artificial islands, ditches and canals, that could not be accounted for by any known works of either English or Indians —though this conclusion was not forced upon him until long after he had begun his investigations. With untiring industry he collected and pored over scores of ancient and almost inaccessible maps and manuscripts, and went afoot over nearly every acre for miles in the Valley of the Charles. Despite all this, his work is not known to the world at large as it should be, nor appreciated at its value outside of a very small circle of those who are ready to listen to proofs instead of dismissing as groundless statements they will not be at the trouble to verify by a slight outlay of time and labor.

Professor Horsford preferred not to make any excavations until every other source of knowledge had been exhausted; and it was not until May of this year that careful examination was made of certain places that seemed to promise good results.

Most important among these was the site of the house built by Thorfinn, who planted the first colony in A. D. 1007, within a few rods of the present site of the Cambridge Hospital. It was discovered that the foundation wall had been made by digging a trench around a rectangular space measuring about sixteen by sixty-four feet. In this trench, which was about two feet in width, were placed stones varying in size from small pebbles to boulders as large as man could readily lift, and in sufficient numbers to prevent the logs or timber resting on them from coming in contact with the earth below or at the sides; but they did not extend above the surface.

Within this foundation, at nearly equal distances from the ends and from each other, were two circular pavements some four feet in diameter, of small stones carefully laid in by hand. They were in the proper position for hearths or fire-places, but although the earth under and about them contained charcoal and ashes, the stones themselves showed no marks of heat.

The building was very similar to the long houses of the Iroquois; the same type may also be found among the timber cutters in our pine forests.

before them, but the truth will now lie with him who digs without fear or favor. If the Sea Rovers lived long there, and built many houses, if they buried many dead there, then the sure evidence of arts known and practiced by Norsemen will see the light, and Mr. Fowke will not ask his friends to agree with him till he holds such proof in his hands.

H. C. Mercer.

Another type of houses, of which there are numerous examples, consists of a cellar-like excavation in a hill side, the floor being level and the height of the back wall varying according to the slope of the hill and the size of the house.

The first of these opened is near Stony Brook Station on the Fitchburg Railway. It is just at the foot of a kame, and at a point where an ancient dam extends across a little brook a few yards away. At the front was a wall about sixteen feet long of small boulders ; another wall of similar stones was a foot within this, somewhat shorter than the first and slightly curved. From the ends of these walls the ends of the hut were marked by two rows of stones at irregular intervals, four or five boulders similarly placed marking the line of the back wall. At the middle of the excavated area was a carefully placed layer of pebbles, covering a space seven feet long and three feet across. This was very probably a hearth, though as in the case of Thorfinn's house there were no marks of heat. At the left front corner of the house was a pavement four by five feet of cobblestones, extending toward the end of the dam, but not reaching to it.

A short distance from this hut site was another not more than ten feet square within the foundation walls. There was no continuous wall in this; but at each front corner three or four stones had been piled to make a support for the timbers, and a row of stones extended for five feet back from one corner. One stone at the opposite side, and two or three at the back formed the remainder of the foundation. There was a small pavement of pebbles at the center but they were not arranged in any order.

A third hut, not far from East Watertown, differed from all others opened in being narrower at the back than at the front. Boulders were at each front corner, one on each side, and two at the rear. The evidence was more distinct in this than in the others, that the roof had been of sod or turf with a covering of small stones, as the interior space was filled for more than a foot in depth with a mingled mass of black earth and pebbles that could have come only from the caving in of the top.

At several places, in the neighborhood of these houses are ancient cemeteries, most of them on sloping ground, some of them on hill sides so steep as to be difficult of ascent. The grave sites are indicated by cairns, generally about six feet in diameter, few of them varying a foot from this size. It has been generally supposed that these stone piles are due to the clearing up of the ground at some former time: but many of them are on slopes so steep that no effort at cultivation

would ever be made; some are composed entirely of pebbles few of which exceed a goose egg in size while all about them are large boulders that would materially interfere with any farming operations that might be attempted. In only one of the graves opened was there any evidence of an excavation more than a few inches in the soil. It appears that the body was laid on the surface with a coveriug of brush or timber over which the stones were piled. It would seem scarcely reasonable that a people as far along toward civilization as the Norse were at that time would adopt such a mode of burial; but these cairns were beyond doubt intended for this purpose, and it must be remembered that in their native home the scarcity of soil made it necessary that corpses be thus disposed of instead of being interred. People tenaciously adhere to what is customary in such matters—as witness the wide-spread opposition to cremation.

What has been so far done in the field is only a beginning; while Professor Horsford has seemingly left little for any one else to do in collecting maps and collating the evidence of history as embodied in the Sagas, it is possible there may yet be among the old Scandinavian and Icelandic records something that will throw unexpected light on the subject. But there remains a great deal to do in the strictly archeologic line. More of the hut sites are to be excavated, and the soil immediately around them and the long houses is to be carefully examined, as there is always a possibility of the preservation of some object that will furnish indubitable proof of what is sought. This is necessary not alone in the vicinity of Cambridge, but all along the coast from Long Island Sound to the Saint Lawrence, as this whole region is said to contain to some extent remains similar to those above mentioned. A careful study is desirable also, of the sites of settlements in other countries where these people have lived; especially in Greenland whence many if not a majority of the earliest settlers of the Charles River Valley were derived.

GERARD FOWKE.

Progress of field work in the Department of American and Prehistoric Archæology of the University of Pennsylvania.—The believer in Man's great antiquity in Eastern North America is again called upon to explain a serious doubt. The easily accessible broad and well lit shelter of the Forge Cave (1 mile below Barren Springs, left bank of the New River, Pulaski County, Virginia), as explored by us in February, 1894, has astonished us again with the modern look of the evidence furnished.

Instead of several ancient midden beds interlaid with stalagmite breccia or cave earth indicating the lapse of successive epochs and the comings and goings of pre-Columbian peoples, our six-sectioned trench, 36x24x10 feet (Section 3 to rock bottom) at deepest, showed:

(1) Red earth left by nitre leachers in 1863–64, with bottle glass, nails, domestic fowl bones, etc., 15–17 inches. (White Man).

(2) Charcoal and ashes in hearth layers, sometimes invaded by diggings from above, sometimes undisturbed, with arrowheads, chips, unglazed pottery, and bone awls, 7 to 9 inches. (Predecessor of White Man).

(3) Rough, unworn blocks of limestone, larger towards the bottom, containing, for some distance down, infiltrations from layer No. 2, resting on the rock floor, 8 feet. (No trace of human or animal occupancy).

Here then, as at the Nickajack and Lookout Caves in Tennessee (explored in December, 1893), we had found but a single stratum of human occupancy (no. 2) below the superficial glass, nails and domestic animal bones of the White Man.

While in it (stratum 2), instead of a predominance of the relics of extinct or probably ancient animals bedded in the fossil preserving charcoal, we discovered the presumably modern remains (kindly identified by Professor Cope) of the Unio, Paludina, Catfish, Tortoise, Frog, Domestic Fowl, Bird (undetermined), Turkey, Marmot, Ungulate (undetermined), Beaver, Lynx, Domestic Sheep, Elk and Deer.

Only in one instance gnawed by rodents and often interlaid between undisturbed hearths, the presence and position of the bones and shells demonstrated them to be the remains of a fauna preyed upon by Man, while the 5 potsherds (3 showing decorative incisions), the 12 bone awls, the triangular chert arrowhead and infrequent hornstone chips, found in the midden layer, proved it the work of the same Indian, who, 8 miles above had scattered his riverside camp site with bones of the Deer, and had dropped pottery, earthen pipes, a polished celt, hornstone chips, and hammer stones. At a surface feasting place twenty miles below, I found the remains determined by Professor Cope to belong to the Unio, Paludina, Trypanastoma, Catfish, Turtle, Soft Shelled Turtle, Raccoon, Bear, and Deer.

This proof that no earlier people than the Indian resorted to the Forge Cave (and the Lookout and Nickajack Caverns), may indicate that no earlier people than the Indian ever inhabited the upper valleys of the New River and the Tennessee. But further search is needed to

establish the conclusion, while objections to the final value of all such cave layer tests for Man's antiquity must be thoughtfully weighed.

The first is suggested by Professor Cope, that as the caves explored by me lack fossil remains, the old (Plistocene) ends of caves with their animal and, if we can believe it, human remains, have probably been worn away. Caves, therefore, would not tell the whole human, as they do not tell the whole animal story, since Man may have inhabited parts of caves which have disappeared.

This, if true, would exclude the alleged Tertiary Man of Thenay or Otta from caves, but would leave us our witnesses for any possible Plistocene blade chipper of Trenton and Madisonville.

Another objection to cave evidence is advanced by Dr. Brinton. Like the Veddas of Ceylon (who are supposed, on the authority of the brothers Sarasin, to have avoided rock shelters), early Man, he suggests, was probably *arboreal* and did not inhabit caves. But continual avoidance of available and conspicuous natural shelters by primitive peoples anywhere is hard to imagine. We have the trace of all kinds of Paleolithic, Neolithic and post-Neolithic peoples in caves in Europe and the evidence of explorers as to still existent savages visiting caves is scanty and insufficient.

If we are not hunting "Cave Dwellers," and if proof of Man's presence is all we want, then a few surface gathered trouser buttons and bottle chips will do for the White Man, arrowheads and bone needles for the Indian, and a breccia—let us suppose with Mylodon teeth and "Turtlebacks"—for some one else. Nothing short of cave avoidance by the savage will rob us of the evidence which a fire kindler or two in a century would suffice to furnish.

H. C. Mercer. March, 1894.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Entomological Society of Washington.—June 7, 1894.—The 100th regular meeting. Twenty-two members present. Mr. Charles Palm, of New York City, elected a corresponding member. President Ashmead made some brief remarks congratulating the Society upon attaining its 100th meeting and upon its prosperous career and prospects. The Recording Secretary, Mr. Howard, read a review of the work of the Society during the past ten years. Mr. Pergande presented certain additional observations upon the habits of *Ammophila gryphus* for publication. Mr. Benton read a paper entitled "Observations on the Mating of Queens of *Apis mellifica*," showing that the queens mate twice. Discussed by Messrs Riley, Gill, Schwarz and Pergande. Mr. Chittenden presented for publication some biological notes on certain Coleoptera. Mr. Schwarz presented a paper on the composition and extent of the Coleopterous fauna of Alaska, giving a lengthy outline of the history of the entomological exploration of that country, commenting upon the results of a trip taken by himself and Mr. H. G. Hubbard in 1892 through parts of Oregon, Washington and British Columbia, and showing that the Alaskan fauna predominates along the coast range of Oregon and Washington. Discussed by Dr. Gill. Mr. Schwarz also read some notes on the West Indian Sugar-cane Borer (*Xyleborus perforans*) and showed the difficulty of determining whether this insect really occurs in the United States. Discussed by Messrs Riley and Howard. Under the head of short notes and exhibition of specimens, Mr. Heidemann exhibited certain rare Pentatomids and Professor Riley announced the rearing of perfect females of Margarodes. He showed that Margarodes and Porphyrophora are synonyms.

L. O. Howard,
Recording Secretary.

N. Y. Academy of Sciences, Biological Section, May 14.—The following papers were read:—

Professor E. B. Wilson, "Experiments on the Horizontal Isotropy of the Egg;" Dr. Arnold Graf, "On the funnels and vesiculae terminales of *Nephelis*, Clepsine and Autostoma;" O. S. Strong, "On Lithium bichromate as a hardening reagent for the Golgi method."

Bashford Dean,
Rec. Sec. of Section.

Boston Society of Natural History, May 16.—The following paper was read:

Mr. A. W. Grabau: Ancient and modern channels of the Genesee River. Stereopticon views were shown.

SAMUEL HENSHAW,
Secretary.

SCIENTIFIC NEWS.

Professor G. J. Romanes.—We have to announce the recent sudden death of Professor Romanes. He was born in Kingston, Canada, in 1848, and graduated at Cambridge, England, in 1870. In 1873 he was Burney prize essayist, and Croonian lecturer in 1875. His first important investigation was on the anatomy and physiology of the nervous system of the Medusae, and he first placed our knowledge of this subject on a definite basis. His works on the evolution of mind in the lower animals and man are the best we have on the subject. He was a prolific writer on evolution, and leaned sometimes to the Neolamarkian, sometimes to the Neodarwinian opinions. In his latest work he revised the opinions of Weismann, and showed the important modifications which they have undergone. The death of Professor Romanes is a serious loss to science.

The Peary Auxiliary Expedition.—The members of this expedition dined together at St. Georges Hotel, Brooklyn, June 17th, preparatory to taking passage on the steamer Portia for St. Johns, N. B. A farewell dinner was given to Henry G. Bryant, the leader of the expedition and his colleagues at the Art Club, Philadelphia, on June 18th by the members of the advisory committee of the Geographical Club. At St. Johns they expect to be joined by the steam whaler Falcon, on which they will sail for North Greenland to look for Lieut. Peary and his party.

The members of the expedition are Professor Wm. Libbey, Jr., of Princeton University, geographer; Professor T. C. Chamberlin, of the University of Chicago, geologist; Dr. Axel Ohlin, of Sweden, zoologist; Dr. H. E. Wetherill, of Philadelphia, surgeon; H. L. Bridgman, of the Brooklyn Standard-Union; Emil Diebtsch, of Port Royal, S. C., civil engineer.

When the Portia sails to-morrow she will have on board the usual Arctic outfit of snow shoes, sledges, ice axes, tents, etc. The vessel

will probably reach St. Johns about the 26th of this month, and by the 4th of July, it is thought, the Falcon will sail for the far North.

It is hoped that Peary's headquarters in Bowdoin Bay will be reached by July 25. If assured of the safety of Peary's party, some of the members of the expedition will then pay a brief visit to Ellesmere Land in their search for the missing naturalists, Bjorling and Kallstenius, who were ship-wrecked on the Carey Island two years ago.

The auxiliary expedition and the Peary party, it is expected, will leave Bowdoin Bay, September 1, and sail on the Falcon for this city, arriving here probably by the 15th of that month.

The Retirement of Professor Dana.—The resignation of Professor Dana from the position he has long held in Yale University is announced.

Professor Dana is eighty-one years of age, and is compelled to abandon further active work by feeble health. His resignation has just been accepted. He graduated from Yale in the class of 1833, returned to college as tutor and succeeded to a full professorship fifty years ago. Since then he has had charge of the department of natural science.

Born in Utica, N. Y., February 12, 1823, Dr. Dana early became interested in the researches of Professor Benjamin Silliman, and through them was attracted to New Haven. Under his guidance he was graduated from Yale in 1833 and immediately appointed instructor of mathematics to midshipmen in the United States Navy, and in this capacity visited the seaports of France, Italy, Greece and Turkey while on board the warships Delaware and United States. In 1836–38 he was assistant to Professor Silliman in the department of chemistry at Yale, and while thus engaged was appointed mineralogist and geolgist to the exploring expedition to the Southern and Pacific Oceans under Captain Charles Wilkes. He was on the corvette Peacock, wrecked at the mouth of the Columbia River. He returned in 1842 and spent some years on his portion of the report, which was partly prepared in Washington. In 1844 Dr. Dana married Professor Silliman's daughter, Henrietta Frances, and he has since continued to reside at New Haven. In 1850 Dr. Dana was appointed Silliman Professor of natural history and geology at Yale, and the same year became associate editor of the *American Journal Science and Arts*, founded by the elder Silliman in 1819. Later he became editor-in-chief, with his son, Edward S. Dana, as assistant. In 1872 the Geological Society of London conferred on Dr. Dana its Wollaston med-

al, and in 1877 he received the Copley gold medal from the Royal Society of London. He is a member of many of the leading scientific societies of the world, and was President of the American Association for the Advancement of Science in 1854. In 1872 the University of Munich gave him the degree of Ph. D., and in 1886 at the Harvard celebration he was awarded the degree of LL. D.

Professor Dana's principal works have been on Corals and Crustacea, and in Geology and Mineralogy. His text-books of the latter subjects are so well known as to require only mention here.

The Wistar Institute of the University of Pennsylvania.—This important addition to the many courses of the University is the gift of General Isaac J. Wistar, a son of Dr. Caspar Wistar, one of the earliest professors of anatomy at this institution. The preservation and exhibition of the Wistar Anatomical Museum is the principal object of the institute. There will also be added to it a complete collection of all objects necessary for the successful study of biology, anatomy and the historical development of the organs in man. The department will be so thoroughly equipped from a scientific standpoint that it will be used not only for purposes of exhibition but also for practical teaching. Advanced research will be the most striking feature of the work.

In connection with the institute there will be established a course of lectures which will give graduates of the medical department opportunities for post-graduate courses and deeper research in the advanced stages of anatomy and biology.

A periodical will be published, in which these subjects will be treated by men who have become celebrated because of their knowledge of these important subjects. In this building will be placed the present museum of anatomy, known as the Wistar and Horner Museum, which was presented to the University by the widow of Dr. Caspar Wistar, which gift was afterward supplemented by those of Mr. Horner. In addition to this the museum now used in connection with the Biological School will be placed in the building as soon as it is completed.

It has been decided to place the management of this institute under the direction of a Board of Managers elected by the Trustees of the University. In order that the memory of the founder of this department may be perpetuated in fitting recognition of the appreciation felt at the benevolence of General Wistar, it has been settled that one of the managers shall be a descendant of the Wistar family. The other

two will be the President and Vice-President of the Academy of Natural Sciences.

The University will elect a dean of the department, who will devote his entire time and energies to the development of the manifold interests of the institute, which gives promise of being one of the greatest of its kind not only in this country, but also will rank high among similar departments in the European schools of anatomy. Fellowships will be established in order to afford deserving students ample opportunity for extended researches in this department.

Dr. Horace Jayne, the retiring dean of the college department of the University, has presented his famous anatomical collection, purchased some years ago from the renowned Collector Wade, to the Wistar Institute. The collection is composed principally of mammals, including a large number of alcoholic specimens and a complete set of rhinoceros skeletons.

Work on the building was begun less than two years ago. It is of buff brick, plainly but handsomely finished in buff terra cotta, and so constructed as to permit of additions being made with facility. The structure is thoroughly fire proof, and is provided with the most approved fire-escapes. It has a depth of sixty-six feet on Woodlaud Avenue, and a frontage of two hundred and thirty-seven feet on Thirty-sixth Street. On the latter thoroughfare is the broad entrance leading into a large vestibule eighteen by twenty feet. To the left of the entrance the curator's room is situated, and to the left is the lecture room connecting with the professor's room. The main entrance from the vestibule leads into the main hall, the dimensions of which are forty-four by thirty-six feet.

Passing through the hall to the left one will find the main museum a roomy apartment of fifty by one hundred and ten feet, furnished throughout with all the appliances necessary for an institution of the sort. Two smaller rooms toward the Spruce Street end are reserved for the reception of private collections.

The second floor will be devoted principally to work-rooms and professors' apartments. It will also contain a library and a museum corresponding in size to the one on the lower floor. Three more work-rooms are located on the third floor, with quarters for the janitor. There will also be another museum formed of galleries eighteen feet wide, overlooking the similar department on the floor below.

The basement will be devoted exclusively to work-rooms, all of which will be furnished with zincs, flues and other appliances necessary

for dissecting work. The height of the basement is twelve feet, and that of the other floors, fourteen, twelve and twelve respectfully.

At the opening exercises, there was a fair assemblage notwithstanding the very unfavorable weather. Addresses were made by Provost William Pepper, Director Harrison Allen, M. D., and Professor William Osler, M. D., of John Hopkins, formerly of the University of Pennsylvania.

Major J. W. Powell has resigned from the Directorship of the U. S. Geological Survey, and Mr. C. D. Walcott has been appointed by the President and Senate to take his place.

Professor H. S. Williams formerly of Cornell University, takes the place of Professor J. D. Dana in Yale University.

Among the books announced by MacMillan & Co. for early publication are:—" A three months course of practical instruction in Botany" by F. O. Bower; a "Course in Experimental Psychology" by J. McK. Cattell; "Physiology for Beginners" by Michael Foster; "Methods of Histological Research" by C. von Kahlden, translated by C. Morley Fletcher; "Text-book of Invertebrate Embryology" by Korscheldt and Heider, translated by E. L. Mark and W. M. Woodworth; "Lectures on Human and Animal Psychology" by Wilhelm Wundt, translated by J. E. Creighton and E. B. Tichener; and a series, the "Cambridge Natural Science Manuals" edited by A. E. Shipley and containing " Elementary Paleontology—Invertebrate" by Henry Woods; " Practical Physiology of Plants" by F. Darwin and E. H. Acton; "Text-book of Physical Anthropology" by Alex. Macallister; " The Vertebrate Skeleton" by S. H. Reynolds; "Fossil Plants" by A. C. Seward; and "Elements of Botany" by F. Darwin.

We regret to learn that our contemporary "Science" has suspended publication for want of sufficient financial support.

The Philadelphia Zoological Garden has received specimens of the Indian cats, *Felio bengalensis* and *F. viverrinus.*

Errata in June NATURALIST.—For Fig. 4, p. 530, read Fig. 2. For Fig. 2, p. 529, read Fig. 3. For Fig. 3, p. 530, read Fig. 4.

PLATE XVII.

Tobacco Pipe of Earthenware from Shell-Heap, Mulberry Mound, Florida, (full size.)